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U.S. Department
of Transportation
**Federal Aviation
Administration**

Federal Aviation Regulations

Part 33
Airworthiness Standards:
Aircraft Engines

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Part 33

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Introductory Note

Part 33 is codified under Subchapter C, Aircraft, of Title 14 of the CODE OF FEDERAL REGULATIONS.

This FAA publication of the basic Part 33, effective February 1, 1965, incorporates Amendments 33–1 through 33–5 and any changes required by the Department of Transportation transition amendment.

Part 33—Airworthiness Standards: Aircraft Engines

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Part 33—Airworthiness Standards: Aircraft Engines

Adopted: June 3, 1964 **Effective: [February 1, 1965]**

(Published in 29 F.R. 7452, June 10, 1964)

This amendment adds Part 33 [New] to the Federal Aviation Regulations to replace the airworthiness requirements contained in Part 13 of the Civil Air Regulations and is part of the Agency recodification program. Part 33 [New] was published as a notice of proposed rule making in the Federal Register on January 1, 1964 (29 F.R. 15). In addition, Part 1 [New] is being amended to add definitions of "2½ minute power" and "30 minute power" and to correct the definition of "fire resistant".

It should be noted that at this time no definite effective date for this Part is stated. The procedural requirements of Part 13 of the Civil Air Regulations are proposed to be included in Part 21 [New] as published in the Federal Register on May 27, 1964 (29 F.R 7000). Part 33 [New] will be made effective on the same date as Part 21 [New] is made effective. In addition, at that time Part 13 will be rescinded in its entirety.

A number of changes have been made in the proposal, both as a result of comments received and as a result of further review by the Agency. Some of the comments received recommended substantive changes of the regulations. Although some of the recommendations might, upon further study, appear to be meritorious, they cannot be adopted as a part of the recodification program. However, all comments of this nature will be preserved and considered in any later substantive revision of this Part.

Several comments were addressed to the disposition of the procedural requirements of Part 13. As previously indicated, these requirements are proposed to be included in Part 21 [New]. In particular it should be noted that the "equivalent level of safety" provisions presently contained in § 13.10 are proposed to be included in §21.21 [New].

One comment requested the retention of the phrase "as well as aluminum alloy" in paragraph (2) of the definition of "fire resistant". As indicated in the preamble to the NPRM on Part 33 [New], the inclusion of this phrase in the Part 1 [New] definition of "fire resistant" makes this definition inconsistent with the present definition in CAR Part 3. Since there was no intention to make a substantive change when the Part 1 [New] definition was enacted, the Agency feels that the definition in Part 1 [New] should be restated to be consistent with the definition in CAR Part 3.

Comments received questioned the substitution of the phrase "with a propeller ordinarily used on a similar engine" in place of the phrase "with a representative propeller" whenever a propeller is required for an engine test under this Part. Since the proposed language might cause some confusion and might appear to be a substantive change, the Agency is returning to the phrase "with a representative propeller".

In addition, the phrase "when practicable" has been added to § 33.87(c)(7) to make that section consistent with § 33.87(b)(7) and with the present requirements of Part 13. The requirements of § 13.16(a), originally scheduled to be included in Part 21 [New] have been included in §§ 33.57 and 33.99.

The amendment to § 13.254 relating to 2½ minute power for helicopter turbine engines that became effective April 22, 1964 (29 F.R. 5381) has been included as paragraph (d) of § 33.87 and a definition of "2½ minute power" is being added to Part 1 [New].

Other minor changes of a technical nature have been made. They are not substantive and do not impose any burden on regulated persons.

The definitions, abbreviations, and rules of construction contained in Part 1 [New] of the Federal Aviation Regulations apply to Part 33 [New].

In addition, Chapter I of Title 14 is amended by adding a Part 33 [New] reading as hereinafter set forth.

Effective Date. As previously noted, this amendment does not contain an effective date but will be made effective on the same date that Part 21 [New] becomes effective.

This amendment is made under the authority of §§ 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423).

Amendment 33–1

Effective Date of Certain Recodified Rules and Repeal of Certain Special Regulations

Adopted: January 8, 1965 **Effective: February 1, 1965**

(Published in 30 F.R. 535, January 15, 1965

The amendments adding Parts 33—Airworthiness Standards: Aircraft Engines (including amendment 1–5 adding certain definitions to Parts 1 and 35—Airworthiness Standards: Propellers published in the Federal Register on June 10, 1964 (29 F.R. 7452 and 7458, respectively) did not contain effective dates for these Parts.

As stated in the preamble to each of these Parts the Agency could not assign an effective date until the effective date of Part 21—Certification Procedures for Products and Parts was known, since both the airworthiness standards and the procedural rules should become effective simultaneously. Part 21 was published in the Federal Register on October 24, 1964 (29 F.R. 14562) effective February 1, 1965.

In addition, while the provisions of all Special Civil Air Regulations in effect have either been restated as a part of the Federal Aviation Regulations or as Special Federal Aviation Regulations, and have therefore been impliedly repealed, some of them have not been specifically repealed. This amendment therefore, to avoid any possible confusion, specifically repeals all existing Special Civil Air Regulations.

In consideration of the foregoing:

(1) Parts 33, 35, and amendment 1–5 to Part 1 of the Federal Aviation Regulations are made effective February 1, 1965.

(2) All Special Civil Air Regulations not heretofore repealed are hereby repealed effective April 1, 1965.

This amendment is made under the authority of §§ 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423).

Amendment 33–2

Cross Reference Corrections in FAR Parts 21, 33, 37, 43, 61, 63, 91, 127, 133, 141, 145, 149, and 183

Adopted: June 28, 1966 **Effective: July 6, 1966**

(Published in 31 F.R. 9211, July 6, 1966)

These amendments update certain cross references in the Federal Aviation Regulations and make other miscellaneous corrections.

At the time of the recodification, it was necessary to include in the Federal Aviation Regulations cross references to the Civil Air Regulations or Special Civil Air Regulations where the referenced provision had not yet been recodified. These amendments update all these cross references in instances where no substantive change is involved. In some instances, the cross references as updated herein have been anticipated in compilations and reprints of the respective Parts of the regulations.

For convenience, a table is utilized to state the changes that can be accomplished by a mere substitution of the proper cross reference.

The original publication of section 91.101(a) referred to the "Bureau of Commerce" instead of the "Bureau of Customs". This error is being corrected. The introductory sentence of subparagraph (b)(5) of Appendix B of Part 141 is corrected by the addition of a line of text that was inadvertently omitted in the recodification.

Since this amendment does not involve any substantive change and does not impose a burden on any person, notice and public procedure thereon are necessary, and the amendment may be made effective immediately.

In consideration of the foregoing, Chapter I of Title 14 is amended, effective July 6, 1966.

This amendment is made under the authority of section 313(a) of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a)).

Amendment 33–3

Miscellaneous Powerplant Design Requirements for Aircraft Engines and Propellers

Adopted: February 24, 1967 **Effective: April 3, 1967**

(Published in 32 F.R. 3733, March 4, 1967)

This amendment adds miscellaneous powerplant design requirements for aircraft engines and propellers, and withdraws certain proposals for rotorcraft. This amendment is based on, and reflects industry comments concerning, Notice of Proposed Rule Making 66–3, published in the Federal Register (31 F.R. 2485) on February 8, 1966. Except as modified by the following discussion, the reasons for this amendment are those in the Notice. Changes from the Notice, and Agency disposition of industry comments, are as follows:

Consistent with the proposed new definitions of "rated takeoff power" and "rated takeoff thrust", the Notice proposed to amend Part 33 to use those terms in place of the terms "takeoff power", "takeoff thrust" and "takeoff rating" wherever the latter are used. The Notice also proposed to delete the word "rating" wherever applied to engine "speed" since, under the concept of the new engine rating terminology, the term "rating" is properly applicable only to engine powers or thrusts. No adverse industry comments having been received, these changes are issued as proposed. In addition, § 33.7 is editorially amended to make it clear that, under the new terminology, the word "rating" applies to powers and thrusts, and the words "operating limitations" apply to other factors such as speeds, temperatures, and pressures. Consistent with the addition of the word "rated"

to the definitions of "2½-minute power" (and thrust) and "30-minute power" (and thrust), the word "rated" is added where those power and thrust descriptions are used. Further, an inappropriate use of the word "rated" appears in § 33.49(c)(5): The words "normal rated" (speed) and "normal rated" (manifold pressure) are military usage corresponding with the Agency terminology "maximum continuous" (speed and manifold pressure). The latter terminology is used instead. Finally, consistent with the use of the word "rated" to describe approved powers and thrusts, § 33.97(b) is amended by deleting the words "maximum forward" (thrust) and inserting the words "rated takeoff thrust" in place thereof.

The Notice proposed to add a new § 33.8 requiring that the applicant must select power or thrust ratings and that the selected ratings must be for the lowest power or thrust that all engines of the same type may be expected to produce under the conditions used to determine that rating. One comment objected for the following reasons: The commentator states that the current requirements are satisfactory and pose no compromise with safety. The Agency disagrees for the reasons stated in the Notice. The commentator states that production tolerances should not be included in the type certification regulations. This amendment prescribes no production requirement in addition to the present requirement of conformity to the type design in the production requirements of Part 21. This amendment merely resolves an ambiguity concerning the meaning of the rating concept as an aspect of the type design so that there can be no doubt that no production engine conforms to its type design unless it equals or exceeds the specific power or thrust values assigned as ratings under the type design. The commentator states that reduction of ratings to represent the lower end of the anticipated range of power variation would result in aircraft manufacturers receiving engines of less power than those he would otherwise get. The Agency disagrees. The present rules do not authorize a negative tolerance with respect to production conformity to assigned ratings. As stated in the Notice, conformity is not shown unless all production engines equal or exceed the assigned ratings. Since the assigned rating is the aircraft manufacturer's assurance of engine capability, assignment of power ratings to represent the low end of the expected production range of powers or thrusts will reduce unexpected power deficiencies, not cause them as claimed. The commentator states that no rule change is necessary if the industry specified a reasonable production tolerance, and states that this has been the past practice. A reasonable range of expected production power or thrust values is inevitable and is not prevented by this amendment. However the current rules do not delegate to private persons the authority to prescribe negative tolerances so far as meeting minimums prescribed during type certification is concerned. The commentator states that production power variations do not adversely affect safety considering that other variables such as ambient conditions, propeller tolerances and airframe tolerances also exist. The Agency disagrees. Reliance by the aircraft manufacturer upon assigned engine ratings is necessary in order for him to correctly assess, and make allowance for, other production variables related to aircraft production. The commentator states that the hazardous situation cited in the preamble is not pertinent since it was related to the selection of an engine for a prototype aircraft rather than the selection of a power rating. The Agency disagrees. The hazard resulted because (1) the aircraft manufacturer in the example designed for performance based on an assigned engine rating, and (2) certain engines supplied did not meet their assigned ratings and failed to produce aircraft performance that was produced by engines that produced their assigned ratings. It is in the selection of an engine for a prototype that reliance upon assigned ratings by the aircraft manufacturer is necessary to ensure that production aircraft have the performance capabilities of the prototype aircraft. This comment cannot, therefore, be accepted. This amendment is drafted as proposed.

The Notice proposed to amend § 33.17 to require that contact of flammable fluid with hot surfaces be "prevented" rather than "minimized" as at present. This proposal is withdrawn pending further study. The Notice also proposed to delete the words "from heat, vibration, or fluid pressure" at the end of § 33.17(b). No adverse comments having been received on this part of the proposal, this amendment is drafted as proposed.

The Notice proposed to amend § 33.23 to require that maximum allowable engine mounting attachment loads be specified by the applicant and that the engine mounting attachments and related structure be able to withstand the specified loads. One comment

objected, stating that, instead of being required to specify maximum allowable loads, the engine manufacturer should "identify the design cases (e.g. maximum loading, rate of turn, engine seizure torque, etc.) and the associated time factors which were used in determining the critical loads . . . ." Since this comment assumes that critical loads will be determined, it is not clear how the commentator's proposal would differ from the proposed amendment. The "design cases" mentioned by the commentator would be considered under the proposed amendment. The maximum allowable loads should be specified for use by subsequent aircraft applicants for the reasons stated in the Notice. This amendment is therefor drafted as proposed.

The Notice proposed to amend § 33.69 to reflect the single-ignition allowance proposed for Parts 27 and 29. Since those proposed amendments have been withdrawn for further study, the proposed amendment to § 33.69 is withdrawn accordingly.

In consideration of the foregoing, Subchapters A (Part 1) and C (Parts 21, 33, and 35) of Chapter I of Title 14 of the Code of Federal Regulations are amended, effective April 3, 1967.

These amendments are issued under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423).

Amendment 33–4

Fire Detectors and Engine Power Response

Adopted: March 16, 1971 **Effective: April 23, 1971**

(Published in 36 F.R. 5490, March 24, 1971)

The purpose of these amendments is to expand the design and installation requirements for fire detector devices in transport category airplanes, to require a fire detector system in normal category rotorcraft, and to establish more specific requirements concerning engine response to throttle control movement under various load conditions.

These amendments are based on Notice 69–7, issued March 8, 1969, (34 F.R. 5020). Numerous comments were received in response to Notice 69–7 and changes have been made in the proposal based thereon. These changes are discussed hereinafter.

One of the comments stated that fire detectors should be capable of monitoring the worst fire foreseeable and suggested that this language be incorporated into § 25.1203. The FAA does not consider that such a change is necessary. The regulations now require that fire detectors be installed in each designated fire zone and in the combustion, turbine, and tailpipe sections in sufficient numbers and locations to ensure prompt detection of a fire. This regulation is not limited to any particular type of fire, but applies to all fires in the designated areas. It would, therefore, include the worst fire foreseeable. The commentator also requested that the regulation be changed to prevent the fire detectors from being rendered inoperative by a type of fire, such as blowtorching. The FAA is aware that there have been instances in which detectors were rendered inoperable due to blowtorching. However, this has occurred infrequently. Under this regulation, the detector system must still function in the event the sensor or wiring is severed at one point, unless there is a means to warn the crew of the severing, whether or not the severing results from "blowtorching". Moreover, if the system does become inoperative due to a short circuit in the system, a means is required to alert the crew to this condition. The FAA, therefore, believes that the matters raised by the commentator are already adequately covered and that the suggested changes to the proposal are unnecessary.

One commentator suggested that fire detector systems should provide both visual and aural fire warning, contending that visual lights are ineffective in sunlight and that taller pilots are unable to see some warning lights from the normal sitting position. The commentator also urged that all transport category aircraft be required to have installed the newer and more reliable types of fire detection equipment as they become available, and observed that some aircraft presently in service do not provide fire ex-

tinguishing for certain combustion heaters which burn JP-1 fuel and are located in the tail compartment, inaccessible to the crew in flight. With respect to the first comment, the FAA does not believe it is necessary to require both visual and aural fire warning indicators. So long as the type of warning means selected by the manufacturer provides prompt and effective warning of fire to the crew, either visual or aural means may be used. If both visual and aural means are needed to provide effective fire warning, then both means would have to be used. Further evaluation of the proposal has revealed that the term "alert" as used in the proposed § 25.1203(b)(3) may cause some confusion. The intent of the requirement was to provide a warning for the crew and this term is consistently used throughout the regulations. Therefore, the regulation has been revised to require a means to warn the crew in the event that a short circuit occurs. With regard to the second comment, the FAA does not believe it is either necessary or feasible to require that the newer fire detection equipment be installed in the older transport category airplanes. In many instances the installation of the newer detection systems in the older airplanes would be extremely burdensome, if not impossible. Moreover, the FAA is not aware that fire detection systems on older aircraft are inadequate or that they need to be replaced with the newer equipment. In any event, if an unsafe condition were found involving the fire detector system of any airplane now in operation, appropriate action, including an airworthiness directive, would be taken to correct that condition. Regarding the commentator's observation concerning JP-1 combustion heaters, it should be noted that the current airworthiness regulations (§ 25.859) do not require fire protection for all combustion heaters. Section 25.859 requires that combustion heater fire protection must be provided for the region surrounding the heater only if this region contains any flammable fluid system components (excluding the heater fuel system) that could be damaged by heater malfunctioning or could allow flammable fluids or vapors to reach the heater in case of leakage, or if the heater fuel system has fittings that, if they leaked, would allow fuel or vapors to enter this region. Thus, in any region surrounding a heater where the conditions covered in the regulation do not exist, fire protection would not be required. This rule would apply to the situation referred to by the commentator. A change in the current requirements is not considered necessary in the interest of safety.

After further evaluation in the light of various comments received, the FAA has determined that the proposed requirement that a fire detector remain in an operable condition in the event it is severed at one point is unnecessarily restrictive. The FAA has determined that it is not necessary in the interest of safety to require that a fire detector system remain operable after it has been severed at one point or, for that matter, after a short circuit, if there is a means to warn the crew that the system has been severed or that there has been a short circuit. The proposal has, therefore, been changed to require that there be a means to warn the crew in the event that the fire detector system does not continue to function as a satisfactory detection system after the sensor or the associated wiring has been severed at one point or after there has been a short circuit in the sensor or associated wiring.

Another commentator observed that single spot detectors would not meet the proposed requirements since they do not remain operable if severed at any one point, and stated further that the regulation would dictate the use of dual loop detector systems. However, in view of the change to the proposal discussed in the preceding paragraph, single spot detectors could be used if the fire detection system provided the required warning to the crew.

One commentator suggested that the term "fire detector system" be defined to include the sensors, control means, indicating panel, and associated wiring. The commentator also suggested that § 25.1203(b)(1) be changed to refer to the severing of sensors and associated interconnecting means. However, the FAA's recent evaluation of fire detector system failures has shown that only the fire detector sensors and associated wiring located in designated fire zones need to be protected from severing and that failures due to shorts are most likely to occur in designated fire zones. The proposal has, therefore, been revised to refer only to the "sensor or associated wiring within a designated fire zone".

The FAA has also determined on the basis of comments received, that the phrase "remain in an operable condition" does not accurately convey the intent of the proposal.

Safety requires that the crew must be warned in the event that the fire detecting sensor or associated wiring in any designated fire zone is severed unless the system "continues to function as a satisfactory detection system." The proposal has been changed accordingly.

It was proposed to require a means to alert the pilot in the event of a short circuit in the detector system. However, after further consideration the FAA believes that it is not appropriate in the interest of safety to restrict the warning to the pilot and the regulation now provides for a means to warn the crew in the event of a short circuit.

Two of the comments pointed out that the proposal would require an alert in the event of a short circuit even though in a given case the short circuit might not impair the performance of the fire detector system. The FAA agrees that the proposal is not clear in that respect, and that it is not necessary in the interest of safety to require that the system provide an alert to the crew of any short circuit which does not render the detector system incapable of detecting a fire. The proposal has been changed accordingly.

Several comments objected to the proposed requirement that the fire detector be constructed or protected so that when it is in the configuration for installation it would withstand mechanical damage that might occur as a result of routine maintenance performed on the powerplant. The comments indicated difficulty with the scope of routine maintenance and with the requirement that the detector withstand mechanical damage. However, in view of the changes being made to the proposal permitting a warning to the crew in the event that a fire detector sensor or associated wiring is severed at one point, the FAA considers that the subject requirement is no longer necessary. Section 25.1203(g) as proposed in Notice 69–7, has been revised accordingly.

Some commentators contended that the present fire detector TSO (TSO-C11d) should be changed so that the required response time test will allow more than the presently prescribed 5 seconds for high alarm temperature sensors. One of the commentators also suggested that TSO-C11d allow for the effect of airframe structure on response time, and that a pre-flight check be required in order to verify the performance of the detector system if the system is not demonstrated to be unaffected by damage or age. With respect to the first comment, the FAA believes that the 5-second response time now permitted by TSO-C11d is the maximum that can be allowed consistent with safety. However, the TSO does provide for a higher initial temperature for high alarm temperature sensor tests, provided those sensors are used only in the corresponding high alarm temperature installation. Regarding the effect of airframe structure on detector response time, the TSO requirements pertain to the performance of the detectors separate from the many types of aircraft in which they may be installed. However, with respect to the commentator's suggestion, the FAA does not agree that the detector response time in the TSO should be increased to take into consideration the effect of airframe structure. Safety dictates that the TSO detector response time must be met with the detectors in the installed configuration and the proposal is unchanged in this respect. In regard to the last comment, while § 25.1203(d) presently requires that there must be a means to check the functioning of each fire detector circuit in flight, service experience has not indicated that there is a need to require a preflight check to verify performance of the detector system.

There was also a comment which recommended that the system remain in an operable condition or, in the alternative, that there be a means to warn the crew in the event of a break or short in a fire detector element. As previously pointed out, the proposal has been changed to provide for a crew warning unless the system continues to function as a satisfactory detection system after the severing or short circuit.

Upon further review of the proposed amendments to § 25.1203, and in view of some of the above comments, the arrangement of the section is being changed slightly in the interest of clarity. Therefore, that part of the proposed § 25.1203(g) requiring that fire detectors withstand vibration, inertia, and other loads is being incorporated into § 25.1203(b), where it is logically associated with the requirements concerning severing and shorting of the fire detectors.

In regard to the proposed new § 27.1195, one comment was received which urged that the proposed regulation be omitted from the final amendment. The commentator contended that the lower rate of engine failures, including engine fires, for turbine engine powered rotorcraft as compared to the rate for reciprocating engine powered rotorcraft

shows that there is no need for the proposed requirement for fire detectors. The commentator also stated that the provisions in Part 27 requiring that the flammable fluid line and fitting in any area subject to engine fire conditions must be located or shielded to prevent fluid leakage on surfaces hot enough to ignite the fluid, provide a level of safety equivalent to that provided by the present § 29.1203, which requires fire detectors in transport category rotorcraft. Further, the commentator questioned whether the greater fuel load of turbine engine powered rotorcraft was a valid factor in requiring fire detectors, and maintained that engine fires can be detected by the pilot via normal engine instruments. The FAA does not agree that the proposed § 27.1195 is unnecessary. The FAA is not aware that the rate of engine failures, including fires, is lower for turbine engine powered rotorcraft and the commentator has submitted no data to substantiate this claim. In any event, the FAA does not agree that the present § 27.1183(a)(3) provides a level of safety equivalent to that provided by § 29.1203. Although § 27.1183(a)(3) does prescribe standards of safety for flammable fluid line and fitting leakage which are not now provided for Transport Category Rotorcraft, Part 29 is currently being amended in conjunction with other airworthiness Parts and the FAA is updating the standards for flammable fluid lines, fittings, and other components. Further, the additional hot surface area of turbine engines poses a hazardous source for the ignition of leaking flammable fluids on turbine engine powered rotorcraft. It should be noted that § 27.1195 will appy only to turbine engine powered rotorcraft. The FAA does not agree that engine fires on Part 27 rotorcraft are detectable by the pilot through normal engine instruments and the commentator has submitted no data in support of this contention. Finally, the FAA notes that turbine engine powered rotorcraft have higher altitude performance capability than do reciprocating engine powered rotorcraft. The time required for an emergency descent and landing following an engine fire may thus be appreciably greater for turbine engine powered rotorcraft and could exceed the 5-minute period provided by § 27.861 for the protection of the rotorcraft structure, controls, rotor mechanism, and other essential parts in the event of powerplant fires. The immediate detection of turbine engine fires by means of a fire detector system is therefore required in the interest of safety.

A number of comments were received in regard to the proposed §§ 33.73 and 33.89. Two commentators questioned whether the maximum rated power or thrust specified in § 33.73 would include the augmented thrust resulting from after-burning. The intention of the proposal was that the takeoff power or thrust rating used in showing compliance with that section be a rating selected by the applicant for the certification of its engine. However, if the applicant elects to use augmented thrust in establishing the rated thrust of the engine for certification, the augmented thrust need not be used in showing compliance with § 33.73. The manufacturer will have the option of using either augmented thrust or unaugmented thrust in demonstrating compliance with § 33.73, and proposed § 33.73(b) has been revised to make this clear. In addition, after further study it has been determined that the word "maximum" as used in the proposed § 33.73 is not necessary and may cause confusion. The definitions in Part 1 of the FAR's refer to "rated takeoff power" and "rated takeoff thrust", and in the interest of consistency, the phrases "maximum rated power or thrust" and "maximum rated takeoff power or thrust" in § 33.73 have been changed to "rated takeoff power" and "rated takeoff thrust".

Various changes to the wording of proposed § 33.73(b) were recommended to make provision for the differences in power management of the primary propulsion systems of fixed wing and rotary wing aircraft, and to improve compatibility between Part 33 requirements and the landing climb requirements of Part 25. The FAA does not agree that the suggested changes are neccessary. The language of proposed § 33.73(b) was selected to represent the minimum power setting to be used in the certification of all engines. Furthermore, § 33.73(b) is a design requirement for a specific engine thrust response capability without relation to the many power management systems that may be used. Insofar as compability of the new regulation with Part 25 is concerned, the FAA sees no conflict. Section 25.119 allows 8 seconds between the movement of the power lever from minimum flight idle to maximum takeoff position and demonstration of the required minimum climb gradient capability. The extra 3 seconds provided by § 25.119 over the 5 seconds provided by § 33.73(b) should be adequate to provide for any engine power losses due to engine installation, accessory loads, and air bleed. In any event, it is the airframe manufacturer's responsibility to select an engine having adequate

thrust response characteristics to match the expected performance characteristics of the airplane and to comply with the regulations, including § 25.119. The intent of § 33.73(b) is to establish minimum engine thrust response characteristics, and not to deal with airplane performance requirements.

Several comments were received in response to the proposed § 33.89. One commentator suggested that § 33.89(c) be reworded to incorporate the more precise definition of idle power and the 5 second response time provided in § 33.73(b). The agency does not agree with the suggested change. Section 33.73(b) prescribes design requirements, whereas § 33.89 is concerned with operational test requirements. From the standpoint of engine operation, the precise idle power setting used to demonstrate design power or thrust response time is not appropriate, since the variables introduced during the operational test may cause the power or thrust produced by the engine when the power lever is at the specified idle power setting to be somewhat different from the design idle power or thrust. Requiring this test to be run with prescribed power lever positions will result in more realistic test times. The commentator also suggested that a new paragraph (d) be added to include engine operation with variable geometry inlet and exhaust nozzles, and with thrust augmentation. However, this comment is beyond the scope of Notice 69–7 and will be considered in future revisions to Part 33. Another commentator suggested that the requirements of § 33.89(c) be deleted, except for subparagraph (c)(1), and be transferred to Subpart E of Part 33 as design and construction standards since the test facilities necessary to make the determinations required under § 33.89 are not widely available. The FAA does not agree that the requirements of § 33.89 should be transferred to Subpart E. However, the FAA is aware that the necessary test facilities for power extraction may not be available, and analytical means could be used in lieu of the test prescribed for power extraction by §§ 33.89(c)(2) and 33.89(c)(3). Therefore, a new paragraph (d) has been added to permit the use of analytical means for the tests prescribed by §§ 33.89(c)(2) and 33.89(c)(3) for power extraction if necessary test facilities are not available.

Interested persons have been given an opportunity to participate in the making of these amendments. All relevant material submitted has been fully considered.

In consideration of the foregoing, Parts 25, 27, and 33 of the Federal Aviation Regulations are amended, effective April 23, 1971.

These amendments are made under the authority of Sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423), and Section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

Amendment 33–5

Engine Rotor System Unbalance

Adopted: January 8, 1974 **Effective: March 1, 1974**

(Published in 39 F.R. 1831, January 15, 1974)

The purpose of these amendments to Parts 25 and 33 of the Federal Aviation Regulations is to require on turbojet engine powered transport category airplanes an indicator to indicate rotor system unbalance, and to require that a means of connecting the indicating system be provided on turbojet engines.

These amendments are based upon two of the proposals contained in a Notice of Proposed Rule Making (Notice 71–12) published in the Federal Register on May 5, 1971 (36 F.R. 8383). Numerous comments were received in response to Notice 71–12, which the FAA is currently reviewing. The FAA believes that it is in the interest of safety to adopt these two proposals herein without delay, while the final disposition of the remaining proposals is being completed. A number of comments relating to these two proposals were received in response to the notice and except for those indicating agreement with the proposals or merely repeating issues discussed and disposed of in the notice, the FAA's disposition of the comments is set forth herein.

Several commentators expressed doubt as to the reliability of presently available engine vibration indicating systems and suggested proposed § 25.1305(d)(3) not be adopted. They further pointed out that the present equipment is expensive and difficult to maintain. As stated in the notice, the FAA is aware that the currently available vibration detectors are not as reliable as the engines they monitor and to that extent, they may impose an economic penalty; however, a rotor system failure can be catastrophic and the contributions to flight safety gained from a vibration monitoring system that provides the flight crew with an appropriate vibration warning far outweighs any difficulties that may be experienced. The value of the system has been recognized by the aviation industry in that vibration monitoring systems have been voluntarily installed in most turbine powered transport category airplanes currently in production.

Several commentators expressed concern that inadvertent engine shutdowns might possibly result from the failure of the flight crew to differentiate between normal and abnormal engine vibration readings. They point out that variations in vibration levels exist between different engines of the same type as well as on the same engine at different flight and power conditions. The rule, however, does not require that a level of acceptable vibration be specified. It merely requires an indication of "rotor system unbalance" in the engine as installed in the aircraft. The indicator may be employed to sense a trend of vibrations over a period of time, rather than a specific level at a particular instant. The FAA considers the addition of a vibration indicator to be necessary in the interest of safety and that flight crews will be able to properly interpret the indicator readings.

One commentator expressed concern that the proposed vibration indicating system could not be used effectively as the principle means of detecting engine failure. The intent of the amendment does not, however, make the vibration indicator the sole or exclusive monitoring indicator. Rather, it is an addition to the present engine instrumentation and provides additional information on engine conditions.

One commentator proposed use of the term "mounting provisions" instead of "connection" in proposed § 33.29(b) in order to make the rule more general . The term "connection," is a general term and the FAA considers it more descriptive and less restrictive than the term "mounting provision."

It was suggested by a commentator that some engines with damped rotors would not reflect rotor unbalance with an externally mounted vibration monitoring system. The amendment to § 33.29(b) does not require that only an externally mounted system be utilized, but permits any system which would indicate an unbalance of the rotor system. To ensure this intent, the term "vibration monitoring" has been deleted. This change makes the adopted rule less restrictive than the proposed rule while still requiring a system which will indicate rotor system unbalance.

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matter presented.

These amendments are made under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1425), and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

In consideration of the foregoing, Parts 25 and 33 of the Federal Aviation Regulations are amended as follows, effective March 1, 1974.

Amendment 33–6

Aircraft and Aircraft Engines—Certification Procedures and Type Certification Standards

Adopted: September 20, 1974 Effective: October 31, 1974

(Published in 39 F.R. 35452, October 1, 1974)

The purpose of these amendments is to change the procedural requirements relating to the type certification of aircraft and aircraft engines, to update and improve the airworthiness standards applicable to the type certification of aircraft engines, and to incorporate new standards applicable to engines used on supersonic airplanes. In addition, other new airworthiness standards are made applicable to aircraft on which engines type certificated to previous standards are to be installed.

These amendments are based on the Notice of Proposed Rule Making (Notice No. 71–12) published in the Federal Register on May 5, 1971 (36 F.R. 8383). Except for minor editorial changes, and except as specifically discussed hereinafter, these amendments and the reasons therefor are the same as those proposed in Notice 71–12. Numerous comments relating to these proposals were received in response to the Notice and except for those indicating agreement or merely repeating issues discussed and disposed of in the Notice, the FAA's disposition of the significant comments is discussed below. In general, comments received that were beyond the scope of the Notice are not discussed but will be retained for consideration in connection with other rule-making projects as appropriate. Based on the relevant comments and upon further review within the FAA, a number of changes have been made to the proposed rules. In addition, various non-substantive changes of a clarifying and editorial nature have been made. Since these changes impose no additional burden on any person, they may be adopted without further notice and public procedure.

Interested persons have been afforded an opportunity to participate in the making of these amendments, and due consideration has been given to all matter presented.

Two of the proposals of the original Notice concerning engine rotor system unbalance (§§ 25.1305 and 33.29) have been implemented by a separate rule-making action, Amendments 25–35 and 33–5, effective March 1, 1974, that were published in the Federal Register on January 15, 1974 (39 F.R. 1831).

The following discussion is keyed to the like-numbered proposals contained in Notice No. 71–12:

PART 1—DEFINITIONS AND ABBREVIATIONS

Proposal 1—One commentator objected to the inclusion of a turbo-supercharger as part of the engine in the proposed definition of aircraft engines in § 1.1, asserting that in some instances it should be classified as an accessory. However, the intent of the proposal was that turbo-superchargers be included as part of the engine whether or not they are additionally classified as accessories. The definition as adopted has been revised to clarify that a turbosupercharger is part of an engine whether or not it is also an appurtenance or an accessory.

Proposal 2—Several commentators suggested that the term "stop" be deleted from the definition of "idle thrust" as proposed in § 1.1 since a stop is normally associated with the power control lever or throttle, rather than with the engine fuel control device as suggested in the Notice. The FAA agrees with the comment to the extent that the term "idle thrust" should be related to the power control lever and has changed the definition by replacing the term "fuel control device" with "power control lever." Since the term "stop" is appropriate with this revision, it need not be deleted.

One commentator pointed out that several of the proposed amendments used the term "type" in reference to engines and that the word "type" was defined in relation to aircraft in § 1.1 but not to engines. For internal consistency, the definition of "type" has been amended to include the meaning of the term with respect to the certification of aircraft engines.

PART 21—CERTIFICATION PROCEDURES FOR PRODUCTS AND PARTS

Proposal 1—Several commentators suggested that the stress analysis called for in proposed § 21.15(c) for the engine rotor, spacer, and rotor shaft would not normally be available at the time of application for a type certificate, but would be available before actual certification. The FAA agrees and, upon further consideration, has determined that inclusion of the requirement under the type certification standards will allow an applicant to complete and submit a stress analysis after application for a type certificate and before certification. The requirement for a stress analysis has therefore been removed from § 21.15(c) and relocated in a new § 33.62 under the design and construction requirements for turbine aircraft engines.

Proposal 2—Several commentators recommended deletion of that portion of the proposed § 21.35(f) which requires 300 hours of flight test operations for aircraft incorporating engines of a type not previously used in a type certificated aircraft. They contended that the rule discriminated against new engine types, and that unnecessary economic hardships and delays in the aircraft certification program would be imposed. However, experience with newly certificated engine types has demonstrated to the FAA that there is a need for more thorough flight testing of newly certificated engine types, and the regulation with respect to hours of operation is adopted as proposed. Furthermore, the suggestion of one commentator that allowance be made for the use of experimental engines that differ only in minor ways from the type certificated engine has not been adopted because the FAA believes it could lead to uneven administration of the rule.

One commentator questioned whether the phrase "engines that conform to a type certificate" in subparagraph (f)(1) required just one or a full complement of the newly type certificated engines in a multi-engine aircraft. As indicated in the explanation in the Notice, the intent of the FAA is that "engines" means all the engines in the aircraft. To eliminate any ambiguity, the wording has been changed to specifically call for a full complement of engines.

Proposal 3—No public comment was received on the proposal to amend § 21.97 and the section is adopted as proposed.

PART 23—AIRWORTHINESS STANDARDS: NORMAL, UTILITY, AND ACROBATIC CATEGORY AIRPLANES

Proposal 1—One commentator questioned whether proposed § 23.951(b) would prohibit several fuel tanks from gravity feeding through non-return valves to a single collector box from which the fuel pumps would draw fuel. Such an arrangement is not prohibited and the rule would allow any combination of tanks to be used so long as means are taken to prevent air from being introduced into the system.

In response to the suggestion contained in several comments, the icing requirement of paragraph (c) of proposed § 23.951 has been reworded to clarify that it is applicable solely to turbine engine aircraft, since fuel icing is peculiar to turbine fuels. Additionally, since the requirement is intended to preclude interrupted functioning of the fuel system rather than to require operation for an indefinite time, the rule has been revised to require "sustained" operation rather than "continuous" operation.

Proposal 2—Several commentators questioned whether an applicant would have to comply with amended § 23.997, as proposed, if the similar rule in § 33.67 had already been complied with by the engine manufacturer. The FAA proposed the new requirements to assure that newly certificated aircraft would meet the standards prescribed in § 33.67. Thus, if the aircraft manufacturer incorporated an engine which had been type certificated under new § 33.67 the fuel system would already conform to the rule and nothing further would be required. If, however, the aircraft manufacturer incorporated an engine which had not been certificated under the new § 33.67 he would have to take the necessary action to comply with new § 23.997.

Several commentators questioned whether the proposed rule would require that each and every filter in the fuel system, including small screens and so-called "last chance filters," meet the requirements of paragraph (a) through (d) of proposed § 23.997. The FAA intended that at least one filter upstream of the fuel metering device and the engine driven displacement pump meet these requirements, and the section has been clarified accordingly.

In response to a question raised by one commentator concerned with the availability of heat for the required filter or strainer, the FAA wishes to point out that the requirement for icing protection in turbine engine fuel systems, set forth in § 23.951, applies to the entire fuel system.

As proposed, § 23.997(b) would require a drain. Upon further consideration it has been determined that an equivalent of the drain could be provided by having the strainer or filter easily removable for drain purposes and this alternative has been incorporated into the regulation.

Proposal 3—One commentator questioned whether the oil sump of a dry sump engine would be considered as expansion space under the proposal. If the sump is in fact part of the oil tank, then the sump provides the expansion space specified in § 23.1013(b)(1). Further amendment of the requirement is not considered necessary and § 23.1013(b)(1) is adopted as proposed.

One commentator requested clarification of the phrase "that might reduce the flow of oil," used in proposed § 23.1013(e). Several other commentators suggested that the phrase was inconsistent with, but should be identical to, proposed § 25.1013. The FAA agrees with these comments and has revised the section to make it consistent with § 25.1013 in this respect, by specifying that any oil tank outlet screen or guard may not reduce the flow of oil below a safe value at any operating temperature.

Proposal 4—One commentator suggested that the more technically correct term "differential pressure" be used in place of "pressure," in paragraph (c) of § 23.1015. The FAA believes, however, that the present term is adequately understood in the industry, and has not caused any misunderstanding in the past. The paragraph is therefore adopted as proposed.

Proposal 5—Several commentators expressed the belief that the proposed § 23.1019 might be interpreted to require each and every oil strainer or filter in the system including small so-called "last chance" filters to conform to all the requirements of paragraph (a). The intent of the FAA is to require at least one oil strainer or filter that will filter all the oil that passes through the lubricating system while conforming to the requirements of the section. The rule as adopted has been reworded to make this clear. Another commentator objected to the word "conveys" as inappropriate in the lead-in sentence of paragraph (a). The FAA agrees and has changed the wording to refer to a strainer or filter through which all of the engine oil flows.

Several commentators interpreted the requirement of subparagraph (a)(1) for normal oil flow through the bypass as possibly requiring identical flow and proposed the word "adequate" in place of "normal." The FAA does not agree that the word "normal" means identical and used the word normal to mean normal for the system within its operating range. Therefore, the wording as proposed has been retained.

One commentator stated that filters should be serviced on a routine and normal maintenance basis rather than relying upon an indicator as proposed in subparagraph (a)(3). In this connection it should be noted, however, that the rule does not call for relaxing of any maintenance procedures but adds an additional item which will contribute to safety by providing a quick means of inspecting for possible filter contamination.

It was assumed in one comment that the standard engine oil pressure gauge would qualify as an "indicator" as required in proposed subparagraph (a)(3). While it was considered that a separate indicator would be provided, nevertheless, if the applicant can demonstrate that the oil pressure gauge would adequately perform the function of the indicator, a separate indicator would not be required. Upon further consideration, the function of the indicator in terms of contamination of the screen has been reworded for clarity.

Several commentators questioned whether the wording of subparagraph (a)(4) was realistic in requiring that no contaminants be released through the filter bypass. As proposed, the requirement stated an absolute prohibition against release of contaminants. The FAA agrees that the intended purpose may be met by requiring the bypass to be designed to minimize release of contaminants, and the requirement is reworded accordingly.

Proposal 6—Several commentators objected to the requirement in proposed § 23.1093 for operation in falling and blowing snow on the basis that no standard is specified as to the intensity or the amount of falling snow or the degree of blowing involved. They further point out that no uniform means are provided for demonstrating compliance with the section and that a small or even minute amount of snow might satisfy the letter of the law of this section. One commentator offered detailed standards that could be adopted. However, it was not the intent that specifications for all possible conditions be included in the regulation but, rather, that an applicant select the limitations desired for his airplane and then demonstrate the ability to operate within those limitations.

Several commentators asserted that the specified liquid water content of 2 grams per cubic meter was not representative of actual conditions and would result in more stringent requirements for ground operation than for flight, while another suggested that the requirement for icing protection at idle should be applicable "on the ground" rather than at sea level. Upon further consideration, the FAA agrees that a reduction of 0.6 grams would provide an adequate and safe standard for icing protection at idle conditions on the ground and the requirement has been changed accordingly.

One commentator objected to the requirement for icing protection for 30 minutes at idle, stating that there was insufficient bleed air to adequately meet the requirement for this period of time. However, experience has demonstrated that it is practical and necessary for safety of flight, and that protection for the engine during prolonged idle prior to takeoff is essential to safety of operation. The proposal does not restrict the means for icing protection to engine bleed air, as suggested by the commentator, but allows any means or combination of means which the applicant chooses. With respect to bleed air, the intent of the requirement is that icing protection at idle be provided when the bleed air available for icing protection is at its critical condition. The section has been reworded to make this clear.

Proposal 7—Amendment 23–14, effective December 20, 1973, published in the Federal Register on November 19, 1973 (38 F.R. 31816), amended § 23.1183(a) to require that lines and fittings and components carrying gas, air, or flammable fluids in any area subject to engine fire conditions must be at least fire resistant. That amendment also amended the heading of the section, while retaining the requirement that flexible hose assemblies must be approved. Therefore, the section as amended by this amendment, contains the provisions made effective by Amendment 23–14 in addition to those proposed in Notice 71–12, including the revision of the latter discussed below. Inasmuch as the heading proposed in Notice 71–12 is inappropriate to the section as amended by Amendment 23–14, the heading adopted by the amendment is retained.

Stating that proposed § 23.1183, which concerns engine fire protection, is inappropriately included with aircraft airworthiness standards, one commentator suggested that it more correctly belongs in Part 33 relating to engine airworthiness requirements. However, while this and other sections do relate to engine airworthiness, they are included also in Part 23 and the other aircraft certification parts since it is the intent that aircraft certificated under applications made after the adoption of these amendments conform to the new updated sections of Part 33, whether or not they incorporate engines type certificated under the updated Part 33. Thus, to cover cases where such aircraft incorporate engines certificated under applications made before adoption of these amendments, the new engine standards that are appropriate are made effective as to the aircraft by being incorporated in the aircraft airworthiness sections.

One commentator questioned whether integral oil sumps on smaller reciprocating engines were considered to come within the meaning of flammable fluid tanks as that term was used in proposed § 23.1183. The FAA did not intend that they be included, and the rule as adopted specifically provides that integral oil sumps of less than 20 quart capacity need not be fireproof nor be enclosed by a fireproof shield.

Proposal 8—As a result of the issuance of Amendment 23–14 (38 F.R. 31816), which contains new paragraphs, § 23.1305(q) and (r), the proposed paragraphs (q), (r), (s), and (t) are redesignated (s), (t), (u), and (v), respectively. The following discussion is keyed to the new designations.

One commentator questioned whether the fuel strainer or filter indicator referred to in § 23.1305(t) were required on all filters, even "last chance" filters. Consistent with

the requirements applicable to the strainers or filters themselves, § 23.1305(t) has been revised to make clear that the indicator required is for a fuel strainer or filter required under § 23.997. Similarly, § 23.1305(t) and (u) have been reworded in order to be consistent with §§ 23.997 and 23.1019, respectively, in regard to the degree of contamination that must be indicated. In response to a further comment, § 23.1305(t) has been reworded to clarify that the desired indication is of the occurrence of contamination rather than the more stringent requirements of the degree of contamination as suggested in the Notice. This change achieves consistency between paragraphs (t) and (u).

One commentator questioned whether other presently installed gauges for other functions could be used as "indicators" to indicate the functioning of a heater as required in paragraph (v). As discussed above, in connection with the indicators required for oil strainers or filters, the FAA anticipates that the requirement will be met by installation of gauges to indicate the functioning of heaters. However, if a clear and positive indication can be obtained from other gauges used to portray functions different than direct heater functioning, the requirements of the section are met.

PART 25—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

Proposed changes to §§ 25.951 (Proposal 1), 25.997 (Proposal 3), 25.1015 (Proposal 5), 25.1019 (Proposal 6), and 25.1093 (Proposal 7) were the subject of comments substantially the same as submitted for the proposed like-numbered sections of Part 23. As adopted, these Part 25 sections set forth the same requirements as proposed in Notice 71–12 except as they have been modified for the reasons given in the preamble discussion of the like-numbered Part 23 sections.

Proposal 2—No comments were received in response to the proposed deletion of § 25.977(b). That paragraph is accordingly revoked and marked reserved.

Proposal 4—The exemption contained in the last sentence of § 25.1013(a), concerning fireproofing of an integral oil sump of less than 20-quart capacity on a reciprocating engine, has been removed from this section and placed in § 25.1183(a). This action involves no substantive change and achieves consistency with the parallel Part 23 section.

Proposal 8—Section 25.1183(a) has been further amended in connection with changes to § 25.1013(a) as noted under Proposal 4.

Proposal 9—Section 25.1305(c) has been amended so that it is substantively the same as the parallel provision of § 23.1305. The related Part 23 preamble discussion is applicable. The proposed new subparagraph 25.1305(d)(3), concerning an indicator to indicate rotor system unbalance, has already been adopted by a separate rule-making action (Amdt. 25–35, 39 F.R. 1831).

One commentator stated that aircraft fuel systems have been designed without cockpit controlled fuel heat; therefore there is no need in proposed subparagraph (c)(8) for an indicator to indicate the proper functioning of any fuel heater. The section however only requires an indicator if a heater is used and the FAA believes it would supply necessary information to indicate heater functioning.

PART 27—AIRWORTHINESS STANDARDS: NORMAL CATEGORY ROTORCRAFT

Proposed changes affecting §§ 27.951 (Proposal 1), 27.997 (Proposal 2), 27.1013 (Proposal 3), 27.1015 (Proposal 4), 27.1019 (Proposal 5), 27.1093 (Proposal 6), 27.1183 (Proposal 7), and 27.1305 (Proposal 8) were the subject of comments substantially the same as submitted for the proposed like-numbered sections of Part 23. The proposed amendments set forth in Notice 71–12 have been adopted except as explained in the preamble discussion of the like-numbered Part 23 sections.

PART 29—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY ROTORCRAFT

Proposed changes affecting §§ 29.951 (Proposal 1), 29.997 (Proposal 2), 29.1013 (Proposal 3), 29.1015 (Proposal 4), 29.1019 (Proposal 5), 29.1093 (Proposal 6), 29.1183 (Proposal 7), and 29.1305 (Proposal 8) were the subject of comments substantially the same as submitted for the proposed like-numbered sections of Part 23. The proposed amendments set forth in Notice 71–12 have been adopted except as explained in the preamble discussion of the like-numbered Part 23 sections.

PART 33—AIRWORTHINESS STANDARDS: AIRCRAFT ENGINES

Proposal 1—The comments received in response to proposed § 33.5 focused principally on the overhaul instructions that would be required by paragraph (e). The comments revealed widespread misunderstanding of the effect of requiring the engine manufacturer to set out the frequency of overhauls. In this connection, the FAA wishes to point out that overhaul instructions are necessary upon type certification because an engine might require overhaul at any time thereafter, and the ability to perform an overhaul should not be limited by lack of instructions. Furthermore, the manufacturer's statement of overhaul frequency is not established as an operating limitation but operates merely as a recommendation; it does not preclude the establishment of different overhaul intervals, nor does it preclude the "piecemeal" overhaul practice followed by operators using continuous airworthiness maintenance programs. It should be noted, however, that the initial overhaul time established under § 33.90 and referred to in § 33.7(c)(17) is an operating limitation that must be complied with regardless of the adoption of any other practice; the initial overhaul, whether accomplished "piecemeal" or otherwise, must be completed within the time established.

With regard to a question raised by one commentator concerning the requirements in § 33.5(e)(2) that certain component life limits be specified in the required instructions, the FAA wishes to call attention to the fact that no separate requirement is thus established that would have any effect on operators of the engines. The life limits of all components requiring replacement are established under other sections of Part 33 as operating limitations that must be complied with, and their publication in the required instructions is a convenience to operators.

Upon further review, § 33.5(a)(1) is revised to include a requirement that the installation instructions contain the maximum allowable loads for engine mounting attachments and related structure, which are required to be determined in complying with § 33.23. Similarly, § 33.5(a)(2) is revised to include a requirement for description of the pipes, wires, cables, ducts, and cowling covered by that section. That information is considered essential for installation, and FAA practice has been to require it for compliance with prior §33.5.

Proposal 2—The effect of proposed § 33.7 was misunderstood by a number of commentators who objected to various ratings and limitations listed therein. Contrary to the apparent belief of those commentators, no ratings or limitations would be established independently under § 33.7; the section merely contains a list of ratings and limitations established either under applicable requirements of Part 33 that predate the Notice, or under proposed new requirements contained in the Notice. Consideration was thus given to the substance of the comments as they related to substantive requirements proposed in the Notice. Discussion of comments directed to § 33.7 but relating to proposed new requirements is found with other comments under the appropriate section. However, as a result of such comments, one substantive change has been made that affects § 33.7; no rating or limitation need be established for turbine engine internal cooling air flow, and proposed § 33.7(c)(12) has therefore been deleted, with attendant necessary renumbering of the succeeding subparagraphs. Other changes of an editorial nature have been made for internal consistency between § 33.7 and other Federal Aviation Regulations.

Proposal 3—No public comment was received on the proposed deletion of § 33.13, and the section has been revoked and marked "reserved."

Proposal 4—Several comments were received that contained objections to the start-stop stress cycle described in proposed § 33.14 as not being representative of a typical operating cycle that would produce the stresses to be accounted for by the requirement. In particular, there was objection to the requirement that disc and spacer temperatures be stabilized after stopping the engine in order to complete a cycle. The FAA agrees that final temperature stabilization should not be necessary where an applicant can show that the components experience the complete stress range without such stabilization, and the definition of a start-stop stress cycle as adopted includes a provision to allow for such a showing.

Another commentator suggested that the operating limitation be defined as the number of cycles to a detectable crack rather than to failure. The FAA regards a

crack as a failure and the rule as adopted applies not only to cracks but to other types of failures which may occur prior to the occurrence of a detectable crack.

A commentator recommended that spacers be deleted from the section because they would not normally be critical. The FAA disagrees; spacers are a critical item in low cycle fatigue, and the requirement, in this regard, is adopted as proposed.

One commentator stated the belief that the establishment of component life limits would result in a complicated and time-consuming process for extending component life. The FAA points out that the listing of this limit on the type certificate as required by this section provides only an initial limit and will not in any way complicate the procedure for extending the limit. In this connection, the section as adopted is revised to clarify that the required operating limitations and the provision for increasing them apply individually to each rotor disc and spacer.

Proposal 5—Several commentators objected to the new standard of protection proposed in § 33.17(b) for external lines, fittings, and components as necessary because the matter is adequately covered in paragraphs (a) and (c) of that section, while another commentator asserted that, due to considerations of airflow and venting, the requirement should be imposed only on the airframe. The FAA does not agree with these positions. The new requirement in (b) for protection against ignition of leaking flammable fluids is necessary to deal with possible impingement of such fluids on hot surfaces. Furthermore, since engine design necessarily includes considerations of airflow and venting, this requirement in Part 33 will assure that those considerations take account of possible ignition of leaking flammable fluid that could result from its impingement on engine components.

In response to comments questioning the applicability of proposed § 33.17(c) to integral oil sumps on the smaller reciprocating engines, the requirement as adopted is revised to exclude such sumps having less than a 20-quart capacity. The requirement is thus made consistent with the parallel requirements in the aircraft airworthiness parts

One commentator believed that a clear definition of "fireproof" and "fire resistant" was lacking in the regulations and suggested that temperature, duration and flame intensity should be specified as part of any definition. The definitions in § 1.1 of the regulations include both "fireproof" and "fire resistant" and any further changes to these definitions would be outside the scope of the Notice.

One commentator questioned whether under paragraph (e), the accumulation of fluid is interpreted as occurring inside of the engine and suggested that the section should specify unwanted flammable fluid. The FAA agrees that the section is intended to refer to unwanted flammable fluid and is directed to areas internal to the engine. The requirement as adopted is reworded accordingly.

Proposal 6—The comments received in response to proposed § 33.25 expressed general agreement with the intent of the requirement as understood by the commentators. However, several of the comments indicated a need for clarification regarding the applicability of limit loads to accessory drives and mounting attachments. The FAA agrees that the intent of the proposal was that the limit load requirement apply to accessory drives and mounting attachments and the section as adopted is reworded to make this clear.

In addition, as suggested by one commentator, a provision has been added to make clear that the use of engine oil for lubrication of accessory drives and mounting attachments is permitted, with appropriate sealing provisions.

Proposal 7—It was pointed out that reference to "excessive speed, temperature, and vibration" in proposed § 33.27(a) was vague in view of the very specific requirements in proposed paragraph (d). Since it was the intent of the proposal to relate the two requirements, § 33.27(a) as adopted is revised to clearly refer to the specific tests included in the section.

Several commentators objected to the speeds proposed in the overspeed tests required in § 33.27. They expressed the opinion that the rotor speed strength demonstrations which are currently accepted by the FAA and which are 5 percent lower in all cases than the proposed requirements demonstrate an adequate margin of strength.

In this connection, one commentator pointed to 6 million hours of service experience with no disc bursts. The FAA finds compelling merit in these comments and upon further consideration the overspeed requirements as adopted are 5 percent less than those proposed.

Several commentators believed that the proposal to use a test article fabricated with minimum qualities allowed by the specification was an impractical requirement. They expressed the opinion that to conform to the proposal as written would require a component made with all the minimum properties of the specifications, a condition which could not be met. The FAA agrees with these comments and upon further consideration has deleted the proposal.

Several commentators objected to the proposed paragraph (c) of § 33.27 regarding cooling airflow as being too restrictive. They pointed out that in designs where there is more than one cooling passage, one passage could be blocked and still allow passage of an adequate flow of cooling air. While this might be less than normal cooling airflow it might still ensure adequate cooling. The FAA agrees that the proposed requirement would not accomplish the intended purpose and, in connection with the deletion of other proposed requirements relating to cooling airflow that were determined to be impracticable (see discussion relating to §§ 33.7 and 33.87), the section is adopted without the proposed paragraph (c).

Proposal 8—One commentator expressed the opinion that the instrument connection markings required in proposed § 33.29 would be unnecessary if it could be shown that there was no possibility of an instrument being connected to the wrong connection. The FAA agrees that this would satisfy the requirements of the rule and, accordingly, the section as adopted is revised to spe ifically allow this. In addition, the section has been revised by deletion of the word "new" which was inadvertently included in the proposal, to clarify that it applies to all engine limitations.

The proposed requirement relating to rotor system unbalance contained in proposed § 33.29(b), as noted previously in this preamble, has been adopted in a separate rule-making action (Amdt. 33–5; 39 F.R. 1831).

Proposal 9—The only public comment received in response to the proposed new § 33.42 recommended deletion of the requirement but gave no reason for the recommendation. The section is adopted as proposed.

Proposal 10—A comment was received that questioned the speed range that would be applicable to the proposed requirement in § 33.43(a) for a vibration survey with a cylinder not firing. As proposed, the requirement implies the same speed range that is applicable to the engine with all cylinders firing. The FAA agrees that this would be impractical and the requirement is revised to specify that the applicable speed range is from idle to maximum desired takeoff speed rating.

Several commentators questioned whether the vibration test survey specified in paragraph (a) required the same propeller used for the endurance test or a propeller of the same configuration. The FAA intended that the same configuration of propeller could be used for the tests and the rule as adopted is revised to clarify the intent for both propellers and loading devices.

One commentator recommended that § 33.43(a) be revised to exclude the propeller shaft or other output shafts from the vibration survey. The FAA does not agree that they should be excluded since they are the most vital components requiring vibration measurements and tests. However, this does not include any accessory drive shafts, which are required to be loaded under § 33.43(c) in order to assess the effects of such loads on the propeller or other output shaft.

One commentator regarded that the number of cycles to demonstrate compliance for fatigue testing of steel shafts specified in § 33.43(b) should be 10 million rather than 10½ million cycles. The FAA agrees that 10 million cycles represents an accepted standard and the requirement is revised accordingly.

A commentator recommended that § 33.43(c) which requires accessories to be loaded during the vibration tests be deleted as being unnecessary for torsional surveys. The FAA does not agree; the purpose of the test is to disclose possible adverse vibration effects, including any that might be contributed by accessories.

Proposal 11—Several commentators objected to the proposed § 33.45(b) requirement for a recalibration after the endurance test as being impracticable and unnecessarily adding to the endurance test. They suggested that the intent of the section, to ensure that any power loss during the endurance test be determined, could be met by modifying the rule to require a "power check" in place of a recalibration. The FAA agrees that a full recalibration is not required to determine power loss and the section is revised to require a power check in place of a recalibration. In addition, since the section permits use of measurements taken during the final portion of the endurance test, reference to the finish of that test has been deleted.

Proposal 12—Upon further consideration, the parenthetical statement in the first sentence of paragraph (a) of proposed § 33.49 is revised to clarify that the additional testing requirements that apply to a turbosupercharger are completely covered in § 33.49(e)(1)(iii) (proposed § 33.49(e)(1)(iv)). An applicant may elect to run the engine-turbosupercharger combination an additional 50 hours in complying with that requirement, but it is not necessary to do so.

One commentator felt that in § 33.49, the accessory loading provision referred to in paragraph (a) could be interpreted to require the limit load to be applied during all operations. The intent of this rule is to require limit loads only during operation at rated maximum continuous power and rated takeoff power, and the section is revised accordingly.

One commentator recommended that instead of requiring maximum cylinder temperatures during all of the endurance running at maximum and takeoff powers that a shorter time period would adequately demonstrate cylinder assembly integrity. The FAA agrees with the recommendation and the rule as adopted requires testing with cylinder and oil inlet temperatures specified, for 35 hours, the time currently used in certification practice. Furthermore, the FAA agrees with another commentator that as long as the cylinder temperatures are monitored the intent of the section will be met, and the requirement is revised to refer to cylinder temperature, deleting reference to the cylinder barrel and head.

A commentator recommended that the altitude testing requirements for turbosupercharged engines be deleted and the tests be run at sea level condition. The FAA does not agree. The altitude testing requirements are necessary. However, the section as adopted is revised by rewording the lead-in sentence of § 33.49(e) to allow as an alternative that altitude tests may be simulated, and by deleting proposed § 33.49(e)(1)(iii).

Proposal 13—Several commentators objected that the proposed requirement in § 33.55(b) that all adjustment settings and functioning characteristics that can be established independent of installation on the engine be unchanged at teardown is unnecessarily restrictive. The FAA agrees that the intent of the proposal would be satisfied if those functioning characteristics remain within limits established at the beginning of the endurance test, and the requirement is revised accordingly.

Several commentators believed that the requirement proposed in § 33.55(c) that components conform to the type design after the endurance test was too severe, especially since this would require parts to remain within drawing tolerances. The FAA does not agree. The type design includes dimensions within which a component may change in service. A component that sustains wear beyond those limits during a 150-hour endurance test has not met minimum airworthiness standards.

Proposal 14—The last sentence of § 33.57(b) as proposed is amended to require the engine "or" its parts to be subjected to additional tests if required instead of the engine "and" its parts.

As discussed in connection with Proposal 1 of Part 21, new § 33.62 is added to require stress analysis of certain engine parts.

Proposal 15—A commentator recommended revision of proposed § 33.65 to include reference to the allowable engine operating limitations in order to clarify that there could not be a finding of noncompliance if any of the undesired effects resulted from operations beyond those limitations. The section is intended to apply only to operations that are within allowable operating limitations as set forth in the manufacturer's operating instructions and the requirement is revised to make this clear.

In addition, the section is revised to delete the reference to inlet air distortion caused by cross-wind, which is adequately covered by the manufacturer's specification of limiting inlet air distortion, and to ice ingestion, which is adequately covered by other requirements.

Proposal 16—Several commentators recommended that § 33.66 be clarified to avoid the interpretation that a reduction in engine performance due to bleed air would be an "adverse effect on the engine." To preclude this possible misinterpretation, the section is revised accordingly.

Proposal 17—Several commentators suggested that paragraph (a) of § 33.67 be revised to allow for the use of seals and locking devices as alternatives to making the fuel control adjusting means inaccessible. The FAA agrees that these alternative means be used to achieve the desired intent and the section is revised accordingly.

Several commentators expressed doubt that it should be necessary to add any water to saturated fuel since upon cooling the saturated water would precipitate out, thus representing the most critical condition. The FAA does not agree that the amount of water which may precipitate out properly represents the most critical amount of free water possible in the system. The added water is necessary to simulate critical conditions.

Several commentators expressed doubt that § 33.67(b)(6) could be literally complied with and suggested that the aim of the rule was that all means be taken to prevent the release of contaminants, and that an insignificant amount of contaminant release should not violate the rule. The FAA agrees with this comment and the rule as adopted requires design of the bypass to minimize release of contaminants.

Other revisions to the section have been made for the reasons set forth in the discussion relating to § 23.997, which contains like requirements.

Proposal 18—The comments received in response to proposed § 33.68 were similar to those received in connection with the substantively similar provisions contained in Proposal 6 of Part 23, § 23.1093. The section is revised in accordance with the discussion pertaining to revisions of that section.

Proposal 19—Several commentators objected to the requirement in § 33.69 for two igniters; however, this is the requirement of the present rule and the only proposed change to the rule is the requirement for a single igniter for fuel augmentation systems. No objections were received to this provision.

Proposal 20—Several commentators objected to the requirement in § 33.71(b)(6) for cockpit indication of oil filter contamination, where no bypass is incorporated. However, the FAA considers the addition of a cockpit indicator to be necessary in the interest of safety in order to enable the flight crew to prevent engine failure due to oil starvation, that might occur if all required filters in the lubrication system do not incorporate the protection of a filter bypass.

As indicated by other commentators, the words "extreme temperature" as used in proposed § 33.71(c)(9) could be taken to require compliance at temperatures beyond the intended operating range. Such a result would be contrary to the intent of the requirement and the section as adopted is revised to refer to maximum operating temperature. In response to other comments the differential pressure requirement in subparagraph (c)(9) is reworded to clarify that it may not be less than 5 p.s.i. above the maximum operating pressure of the tank.

One commentator considered that the lack of a requirement for a bypass was a serious deficiency in the proposal. The FAA has considered this question many times including extensive discussion at government-industry airworthiness meetings and has determined that due to the serious divergence of opinion the use of a bypass should at present be optional. If no bypass is used, however, the applicant must comply with other safeguards contained in the section to ensure safe operation of the lubrication system.

The remainder of the comments were similar to those made in response to Proposals 3, 4, and 5 of Part 23 and have been responded to in discussion of those proposals. The section has been reworded in part to conform with the changes made to the sections involved in those proposals.

Proposal 21—One commentator recommended that § 33.72 should refer to a "main" filter only. The FAA does not agree; the requirements are meant to apply to each filter or screen incorporated in the system.

Proposal 22—Several commentators believed that § 33.75 as written was confusing and ambiguous. The printed notice was incorrectly worded and the section is rewritten to read correctly.

Several commentators suggested that the word "burst" in subparagraph (b) was ambiguous and needed further definition. The FAA agrees and, accordingly, a further descriptive phrase, "penetrate its case," is added.

One commentator suggested that the phrase "improper operations" be substituted for "bad operation". The FAA agrees with the suggestion and the section incorporates this change.

One commentator objected to consideration of multiple failures, to avoid consideration of an infinite number of possible failures. The analysis however does not require that all possible multiple failures be considered, but uses the accepted standard of consideration of only the probable single or multiple failures.

Proposal 23—One commentator suggested that § 33.77(a)(2) be clarified to ensure that a burst meant uncontained burst that penetrates the case. The FAA agrees that this is the intent of the section and it is revised accordingly.

Several commenators suggested that the footnote to the table be modified to permit the option of demonstrating containment on a component basis for all the test items. The FAA does not agree that this would adequately account for secondary effects except in the case of blade containment in fan engines as noted.

Several commentators expressed doubt that the proposed rate of ingestion of 1½ pound birds was supported by ornithological data or actual flight experience. They suggested that a lesser rate be used. The FAA, after further study and consideration, agrees. Accordingly, the ingestion rate of 1½ pound birds is established at one for the first 300 square inches of inlet area and at one for each 600 additional square inches or fraction thereof, of up to a maximum of 8 birds.

The practical reality of a 4-inch hailstone was questioned in some of the comments. The FAA, after further study, has determined that this size will probably not be encountered in actual flight conditions and the section is amended to delete the requirement.

Several commentators believed that the amount of sand and gravel specified was excessive and not representative of actual conditions. After further consideration, the FAA agrees that the amount proposed should be reduced and the section is revised accordingly.

The FAA agrees with the point raised by several commentators that, in § 33.77(c), some power or thrust loss should be permitted since the ingestion of these objects will certainly cause a temporary power loss. Accordingly, the requirement is revised to permit power or thrust loss that is not "sustained." In addition, § 33.77(f) is revised, upon further consideration, to require testing of water ingestion to take place under takeoff operating conditions rather than the proposed "maximum cruise." This reflects current practice in engine certification.

The ¼ by 1 inch bolt test is deleted since the test for the broken rotor blade is a more stringent test and will adequately account for the effects of the bolt.

A comment was received that objected to the provision in proposed § 33.77(d)(3) relating to obstruction of induction airflow by foreign objects that are stopped by a protective device. The FAA wishes to point out that the subject provision does not state a requirement that must be met by all applicants. Rather, it provides an alternative to testing for the effects of objects that can be stopped by a protective device and prevented, by deflection out of the airflow path or by some other means, from obstructing the induction airflow in any way.

In addition, a new paragraph (e) is included in § 33.77 to incorporate the suggestion offered by some commentators that the effects of ingestion of some foreign objects can be accounted for by the effects of others. Thus, in showing compliance with § 33.77 (a) the applicant is required to test only for that object that is shown to have the most

severe effect. Similarly, for compliance with (b), testing is required for sand and gravel and either the 3 ounce or 1½ pound birds, depending on the size of the engine inlet, as designated in § 33.77(f).

Proposed paragraph (e) is redesignated as paragraph (f).

Proposal 24—One commentator recommended that in § 33.79(a) an acceptable means of compliance to demonstrate cooling be provided for the guidance of the applicant. The FAA, upon further consideration agrees that the section does not adequately establish a definable objective and the proposal is withdrawn for further study. Proposed paragraphs (b) through (f) are redesignated (a) through (e), respectively.

One commentator believed that paragraph (e) of the proposed rule could be misinterpreted as allowing a loss of thrust to the unaugmented engine in an amount equal to that added by the augmentor. To avoid possible misinterpretation, the requirement, adopted in § 33.79(d), is reworded to clarify that the loss of thrust mentioned means only the thrust that is provided by augmentation. Furthermore, upon further consideration, the FAA has revised the requirement to refer only to failure or malfunction of augmentor combustion, since the effects of other possible augmentor failures on engine thrust cannot be reliably predicted.

One commentator recommended clarification of proposed paragraph (f) to ensure that the rotational speed mentioned be the minimum rotational speed at which the thrust augmentation functions. This is the original intent of the paragraph and it is modified accordingly.

Proposal 25—One commentator pointed out an error in th eexplanation of proposed changes to § 33.81. Instead of referring to § 33.43, it should have referred to § 33.87. No change to the adopted rule itself is necessary, however.

Proposal 26—No comments were received on the proposed new § 33.82, and the section is adopted as proposed.

Proposal 27—Several commentators recommended that the requirement in § 33.83 for testing to 110 percent of the desired maximum continuous speed rating be deleted because certain high performance turbine engines may not be capable of achieving this overspeed condition. Upon further consideration, the FAA agrees with the commentators' position and the requirement is deleted.

Other revisions to the section have been made for the reasons set forth in the discussion relating to § 33.43, which contains like requirements.

Proposal 28—Revisions have been made to § 33.85 for the reasons set forth in the discussion relating to § 33.45, which contains like requirements.

Proposal 29—Several commentators requested that the surface temperature requirement be deleted from proposed § 33.87(a)(3) as being difficult to simulate on a test stand. The section is intended by the FAA to require that if an engine external temperature limit be specified by the applicant as being critical, then the applicant must demonstrate satisfactory operation at that temperature. It is pointed out that only those temperatures specified by the applicant need be held at their specified values and the requirement is reworded to clarify this. In addition, the section is revised to provide allowance for more than one test run if all parameters cannot be held at the required values simultaneously.

Several commentators objected to subparagraph (a)(4) of § 33.87 which had called for fuels, lubricants, and hydraulic fluids with the lowest thermal breakdown temperatures allowed by their specifications to be used during the tests . They felt that this was practically an impossible requirement because of the unavailability of fluids and lubricants with all the minimum properties called for. The FAA agrees, and the requirement is revised to call for specified fluids and lubricants used during the endurance tests to conform to their respective specifications.

One commentator suggested that § 33.87(a)(6) be amended to require that only shear and overload loads be tested and that the requirement for other loading during the endurance tests be deleted. The FAA does not agree, but intended that the endurance test simulate actual operation and include testing of the accessories drives themselves as well as other portions of the engine. This requires loading of those drives, and the rule is adopted as proposed.

Several commentators questioned whether the limit load for accessories specified in subparagraph (a)(6) should apply only during maximum power operation. This is the intended construction of the section, and it is amended to reflect this intent.

One commentator expressed concern that compliance with § 33.87(a)(8) which calls for cooling air simulation could not be demonstrated since in a particular engine there may be many divisions of cooling air-flow which might make it virtually impossible to individually regulate each separate cooling airflow path. The FAA agrees with the commentator's position and the proposal is withdrawn for further study.

Several commentators suggested that the references to supersonic engines be deleted because of the lack of foreseeable need for such engines. The FAA does not agree. One of the purposes in formulating these new amendments is to establish standards for that new generation of engines, especially since the FAA is in the process of presently certificating such engines.

One commentator pointed out that the proposal did not include the false start tests of the present rule. This was an inadvertent omission and those false start tests are included in the adopted rule.

Proposal 30—The phrase "for installation in an engine" is deleted from § 33.88 as being surplusage.

Proposal 31—One commentator requested that a better definition be used in § 33.89 (b) for the term "extreme ambient temperature and altitude." The FAA agrees that, taken literally, the requirement could be unnecessarily burdensome. Accordingly, the wording is modified to read "maximum and minimum operating ambient temperature" and "maximum operating altitude." In addition, upon further consideration, the last sentence of the proposed requirement is deleted as unnecessary.

Proposal 32—One commentator believed that for the overhaul test of § 33.90 two starts per hour was unnecessarily severe and suggested that a number representative of intended operation might be substituted for the stated requirement. The FAA agrees that if the applicant could show that a lesser number of starts would be more representative of intended operation for the particular engine that this would adequately comply with the intent of the section, and the section is revised accordingly. Furthermore, since this revision eliminates the distinction in the section between airplane and rotorcraft engines, the requirement is expressed in a single paragraph, rather than in (a) and (b) as proposed.

In response to several comments, § 33.90 as adopted is revised to clarify that the requirement applies only to engines being originally type certificated; it does not apply to engines being certificated through amendments to existing type certificates or through supplemental type certification procedures.

Several commentators recommended deleting the entire section as proposed. They expressed the opinion that it was unreasonable to require the completion of an overhaul test in addition to the endurance test as a condition of type certification and believed that past practices were adequate to establish an initial overhaul period. One commentator stated that the 150 hour endurance test, because of its accelerated nature, should be equivalent to a 1000 hour overhaul period. The FAA does not agree. This additional overhaul test is necessary since experience on certain engines has shown that the endurance test has not been equivalent to longer service operations, especially for periods as long as 1000 hours.

Proposal 33—Several commentators pointed out that the oil tank requirement in paragraph (c) of proposed § 33.91 was redundant with a similar proposed requirement in proposed § 33.71(c)(9). The specified test requirements for oil tanks are covered under § 33.71(c)(9) and reference to oil tanks is, therefore, not included in § 33.91(c) as adopted. References to "extreme temperature" and "the sum of 5 p.s.i. and the maximum operating pressure" in the requirements specified in § 33.91(c) have been revised for reasons discussed in connection with Proposal 20, this Part (§ 33.71). In addition, and for the same reason, references to "extreme temperature" in § 33.91(d) have been replaced by "maximum and minimum operating temperature", and the requirement to test while cycling operating conditions from "one extreme to another" has been rewritten to require cycling between maximum and minimum operating conditions.

Proposal 34—Several commentators expressed the opinion that the tests required under § 33.92 are unnecessary for engines that are to be used in single engine aircraft. One commentator further suggested that the time period of 3 hours may not be appropriate to a practical situation but rather, the time period and r.p.m. should be based upon the conditions arising from a recommended flight technique following an engine failure at a critical point in the flight path. Another commentator expressed doubt that windmilling for 3 hours without oil was a normal expectancy. The FAA does not agree. It is not possible, at the time of certification, to know the end use or particular intended flight conditions for each engine. It is therefore necessary to establish a general criterion which will adequately demonstrate a degree of safety for conditions that a turbine engine would likely encounter on a typical and usual route structure. The 3 hour time period specified does represent a time period representative of an expected route structure and windmilling for 3 hours without oil is a reasonable possibility.

One commentator recommended that the proposed rule be clarified to specifically allow for the engine windmilling speed to either decrease or stop due to freezing of bearings. The proposal as written does not specifically mention this condition. However, the FAA agrees that this would be a satisfactory means of accomplishing the intent of the section and the rule is revised to allow for this condition.

One commentator recommended deletion of the entire section because he believed there was insufficient experience pointing out a need for these tests and because the proposal implies a flight test as a condition of engine certification. The FAA finds that experience establishes the need for these tests and points out that flight tests are not specifically required by the rule.

Proposal 35—The changes to § 33.93 are similar to those made for § 33.55, which was the subject of similar comments. The changes and comments are discussed in connection with Proposal 13, this Part.

Proposal 36—The changes to § 33.99 are similar to those made for § 33.57, which was the subject of similar comments. The changes and comments are discussed in connection with Proposal 14, this Part.

Finally, it should be noted that a number of the rule changes contained in this amendment deal with subjects for which proposals were received for inclusion in the 1974–75 Airworthiness Review Program (Notice 74–5; 39 F.R. 5785). As indicated in that Notice and in Notice 74–5A (39 F.R. 18662), inviting comment on the proposals received, rule making procedures separate from the Airworthiness Review could result in removal of proposals from further consideration during the Airworthiness Review Program. The FAA has determined that the following FAA proposals presently being processed in the 1974–75 Airworthiness Review relate to issues that are covered by the rules adopted by these amendments, and need not, and will not, be given further consideration during the 1974–75 Airworthiness Review:

Proposal No.	*FAR'S*	*Subject*
677 (with respect to proposed paragraph (q) only)	§ 23.1305	Powerplant instruments
752	§ 25.997	Fuel strainer or filter
784	§ 25.1305	Powerplant instruments
863	§ 27.1305	Powerplant instruments
941	§ 29.1183	Lines and fittings
947	§ 29.1305	Powerplant instruments

These amendments are made under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423), and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

In consideration of the foregoing, Parts 1, 21, 23, 25, 27, 29, and 33 of the Federal Aviation Regulations are amended as follows, effective October 31, 1974.

Amendment 33–7

Airworthiness Review Program

Amendment No. 3: Miscellaneous Amendments

Adopted: December 13, 1976 **Effective: February 1, 1977**

(Published in 41 FR 55454, December 20, 1976)

The purpose of these amendments is to update and improve—(1) the aircraft, engine, and propeller certification regulations; (2) the operating regulations containing airworthiness standards; and (3) related procedural requirements.

These amendments are based on a notice of proposed rule making (Notice 75–10) published in the FEDERAL REGISTER on March 7, 1975 (40 FR 10802) and are the third in a series of amendments to be issued as part of the First Biennial Airworthiness Review Program. The following series of amendments have previously been issued as part of this Airworthiness Review Program:

Title	*Federal Register citation*
Form number and clarifying revisions	(40 F.R. 2576; Jan. 14, 1975)
Rotorcraft anticollision light standards	(41 F.R. 5290; Feb. 5, 1976)

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matter presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon the relevant comments received and upon further review within the FAA. Except for the minor editorial and clarifying changes and the substantive changes discussed hereinafter, these amendments and the reasons therefore are the same as those contained in Notice 75–10.

After issuing Notice 75–10, the following six additional notices of proposed rule making were issued as part of the First Biennial Airworthiness Review Program.

Notice No.	*Federal Register citation*	*Title*
75–19	40 F.R. 21866; May 19, 1975.	Notice No. 3: Powerplant Proposals.
75–20	40 F.R. 22110; May 20, 1975.	Notice No. 4: Equipment Deviation List.
75–23	40 F.R. 23048; May 27, 1975.	Notice No. 5: Equipment and Systems Proposals.
75–25	40 F.R. 24664; June 9, 1975.	Notice No. 6: Flight Proposals.
75–26	40 F.R. 24802; June 10, 1975.	Notice No. 7: Airframe Proposals.
75–31	40 F.R. 29410; July 11, 1975	Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals.

Based upon further review by the FAA, a number of proposals which were contained in Notice 75–10 are not being dealt with herein but will be considered in conjunction with other proposals contained in one of the later Airworthiness Review Program Notices of proposed rule making.

The following discussion is keyed to the like-numbered proposals contained in Notice 75–10:

Proposal 2–1. One commentator suggested that the proposed change to § 21.33(a) be revised to limit the new aircraft engine and propeller inspection and test provisions

to prototypes only. The FAA does not agree. The intent of the proposals was to make the inspection and test requirements in § 21.33(a) compatible for aircraft, aircraft engines, and propellers. The provision applies to the item presented for type certification tests irrespective of whether or not the item is considered a prototype by the applicant for the type certificate. The proposal is therefore, adopted without substantive change.

Proposal 2–2. No unfavorable comments were received on the proposal to amend § 23.23. Accordingly, the proposal is adopted without substantive change.

Proposal 2–3. No unfavorable comments were received on the proposal to amend § 23.141. Accordingly, the proposal is adopted without substantive change.

Proposal 2–4. No unfavorable comments were received on the proposal to amend § 23.143(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2–5. No unfavorable comments were received on the proposal to amend § 23.145. Accordingly, the proposal is adopted without substantive change.

Proposal 2–6. The proposed change to § 23.149(b) concerning the language "without exceptional piloting skill, alertness, or strength" is related to a proposed amendment to § 23.149 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 23.149(b) contained in Notice No. 2 is therefore being deferred until final rule making action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–6 will be considered at that time.

Proposal 2–7. Although no unfavorable comment was received on the proposal to amend § 23.175(c), the FAA believes that clarification is necessary. The term "or thrust" has been added to the end of the language "maximum cruising power" in proposed § 23.175(c)(3). Proposed § 23.175(c)(4) was intended to clarify the requirement concerning trim speed, but the FAA believes the conflict in language with a similar provision in § 23.175(b)(2)(iii) may cause confusion. Therefore, proposed § 23.175(c)(4) is withdrawn.

Proposal 2–8. The proposed change to § 23.253(b) is related to a proposed amendment to § 23.253(b)(3) that is contained in Airworthiness Review Program, Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75–31; 40 FR 29410 July 11, 1975). The proposed amendment to § 23.253(b) contained in Notice No. 2 is therefore being deferred until final rule making action is taken with respect to the related proposal in Notice 75–31. Comments submitted for Proposal 2–8 will be considered at that time.

Proposal 2–9. No unfavorable comments were received on the proposal to amend § 23.397. Accordingly, the proposal is adopted without substantive change.

Proposal 2–10. No unfavorable comments were received on the proposal to add a new § 23.479(d). Accordingly, the proposal is adopted without substantive change.

Proposal 2–11. One commentator objected to the proposed use of the language "materials used for parts, the failure of which could adversely affect safety" in place of the language "materials used in the structure" in §§ 23.603(a) and 25.603. The FAA does not agree with the commentator's suggestion that all parts of the airplane should, unless specifically excluded, be considered structure. The FAA believes that consideration of the suitability and durability of materials used should be broadened to include parts not normally considered airplane structure.

Proposal 2–12. No unfavorable comments were received on the proposal to amend § 23.607. Accordingly, the proposal is adopted without substantive change.

Proposal 2–13. A commentator questioned whether proposed § 23.675 would require that stops provided to limit the range of motion of an aerodynamic surface be located only on the aerodynamic surface or whether the stop could be located adjacent to the surface. Section 23.675, as proposed and as adopted herein, without change, requires that stops positively limit the range of motion of moveable aerodynamic surfaces. This can be accomplished by locating the stop on structure adjacent to the surface.

Proposal 2–14. No unfavorable comments were received on the proposal to amend § 23.685(a). Accordingly, the proposal is adopted without substantive change. See proposal 2–109.

Proposal 2–15. No unfavorable comments were received on the proposal to add a new § 23.733(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–16. No unfavorable comments were received on the proposed new § 23.787(f). However, one commentator pointed out that the word "contract" in the proposal as printed in the Federal Register should be "contact." The proposal has been corrected to eliminate the printing error. The proposal has also been clarified based on a comment received on Proposal 2–111, to avoid any implication that lamps will be required in cargo compartments.

Proposal 2–17. On commentator questioned the need in proposed § 23.841(b)(6) for a warning indicator at the pilot station to indicate when a cabin pressure altitude of 10,000 feet is exceeded. But as noted by the commentator it is a general industry practice to provide this warning at a cabin altitude of 10,000 feet. The FAA believes that due to the larger number of small airplanes having such awarning many pilots may come to rely on the warning at this cabin altitude. The proposal is therefore adopted without substantive change.

Proposal 2–18. The proposed changes to §§ 23.853, 27.853, and 29.853 concerning the certification requirements necessary to permit smoking in certain aircraft categories are related to proposed standards for § 25.853. The amendments proposed for § 25.853 are contained in Airworthiness Review Program Notice No. 2: Miscellaneous Proposals (Notice 75–10; 40 FR 10802; March 7, 1975) and in Airworthiness Review Program Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75–31; 40 FR 29410; July 11, 1975). The proposals for § 25.853 in Notice 75–10 is being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–31. The proposed amendments to §§ 23.853, 27.853 and 29.853 contained in Notice 75–10 are therefore being deferred until final rulemaking action is taken with respect to the related proposal for § 25.853. Comments submitted for Proposals 2–18, 2–114, and 2–160 will be considered at that time.

Proposal 2–19. One commentator suggested a clarification of proposed new § 23.903(b) noting that the language, "must be designed to give reasonable assurance" would be subject to divergent application. The same language is now used in § 25.903(d)(2), and the FAA believes that experience with this provision in transport category type certification has been satisfactory.

One commentator suggested that a provision similar to § 25.903(d)(1) concerning design precautions to minimize hazards to the airplane in the event of an engine rotor failure be included in proposed §§ 23.903(b), 27.903(c), and 29.903(f). Although several airworthiness directives have been issued to prevent the failure of engine rotors in one engine type, the FAA does not believe that a general requirement for §§ 23.903(b), 27.903(c), or 29.903(f) that is identical to § 25.903(d)(1) is necessary at this time.

Proposal 2–20. No unfavorable comments were received on the proposal to amend § 23.933(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2–21. One commentator objected to proposed new § 23.941 concerning airplanes with variable inlet or exhaust system geometry as being unnecessary and unjustified in Part 23. The FAA agrees that this provision should not be added to Part 23 at this time and is therefore withdrawing the proposal.

Proposal 2–22. One commentator suggested that the proposed changes to §§ 23.971 and 23.999 be revised to require a quick actuation drain valve on each fuel tank. The proposal, however, was not to require new drainage outlets but to establish standards for the drains set forth in proposed § 23.971(b) and present § 23.999(a). The FAA does not have sufficient information to indicate that a need exists for a quick actuation drain valve on each fuel tank considering the large number of different types of fuel tanks which are included on Part 23 airplanes and the use of sediment bowls and chambers. The proposal is therefore adopted without substantive change.

Proposal 2–23. One commentator question the proposed requirement in § 23.977(a)(2) that a turbine engine fuel strainer prevent the passage of any object that could restrict fuel flow or damage any fuel system component. The commentator asserted that a strainer which met this requirement would have an opening so small that ice accumulation with the use of turbine fuels would be a problem. The FAA does not agree. This is identical to the provision in § 25.977(a)(2). Experience with fuel

strainers that would meet the proposed standards in § 23.977(a)(2) has shown that a strainer can prevent the passage of the noted objects and also prevent ice accumulation.

One commentator noted that the clear area of each fuel tank outlet strainer should be at least six times the area of the outlet line instead of five times as proposed in § 23.977(b). This provision is identical to § 25.977(c) and the FAA considers that experience with this requirement in Part 25 has been satisfactory.

Proposal 2–24. The intent of the proposal to add a new § 23.979(e) was to provide strength requirements including load factors, applicable to the airplane defueling system to cover surge pressure during defueling. Upon further review the FAA believes that the proposed amendment is premature. Therefore, the proposal is withdrawn.

Proposal 2–25. No unfavorable comments were received on the proposal to amend § 23.995(d). Accordingly, the proposal is adopted without substantive change.

Proposal 2–26. One commentator suggested that there should be sufficient clearance between the quick actuation drain and other parts of the airplane to allow the fuel sample to be drained into a typical, small container. The FAA believes fuel system drains which meet the proposed requirements of paragraphs(b)(1) and (b)(3) of § 23.999, that the drain discharge clear of all parts of the airplane and that it be readily accessible, will have sufficient clearance to allow a fuel sample to be drained into a small container.

One commentator suggested that the requirement in § 23.999(b)(1)) that the drain must discharge clear of all parts of the airplane, would create unnecessary design and construction restraints. The FAA believes that by coating some airplane surfaces with fuel or by trapping quantities of fuel in certain locations a fire hazard exists. This fire hazard should be limited by this proposal. Further, the FAA believes this requirement can be met without an undue restraint on airplane design.

A commentator asserted that the proposed requirement in § 23.999(b)(3), that the drain valve be either located or protected so that it will not be damaged in the event of a landing with landing gear retracted cannot be justified. The commentator noted that the fuel tanks would be ruptured in such a landing and nothing would be gained if the drain was protected. The FAA disagrees, similar fuel tank installation requirements are set forth in § 23.967 and experience indicates that the fuel system can and should be either located or protected to prevent fuel leakage in such a landing. The FAA does agree that the proposal needs to be clarified to more specifically provide a design specification and has, so modified paragraph (b)(3). Also see Proposal 2–70.

Proposal 2–27. No unfavorable comments were received on the proposal to add a new § 23.1093(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–28. Proposed § 23.1111(c) was misunderstood by one commentator who asserted that it is not possible to assure the impossibility of failure of the engine lubricating system. The proposal, however, was directed toward the elimination of hazardous contamination of the cabin air assuming a failure of the engine lubricating system. In consideration of the misunderstanding, the language has been revised to emphasize the prevention of hazardous contamination of cabin air system.

Proposal 2–29. Although no unfavorable comment was received on the proposed § 23.1125, the FAA believes that the proposal could misunderstood as to whether use of the heat exchanger would permit or prohibit the passage of exhaust gases through the exchanger when hot air was not being directed to the area where it was intended to be used. The FAA's intention was to require cooling of the exchanger wherever it was in contact with exhaust gases, regardless of its usage status. The proposal is revised to make this clear using the language of §§ 25.1125(a)(3) and 29.1125(a)(3). The FAA believes that the exhaust heat exchange requirements should be paralleled in Parts 23, 25 and 29. Therefore the proposed changes to §§ 25.1125(a)(3) and 29.1125(a)(3) are withdrawn.

Proposal 2–30. No unfavorable comments were received on the proposal to amend § 23.1143. Accordingly, the proposal is adopted without substantive change.

Proposal 2–31. One commentator believed that proposed § 23.1165(e) was unnecessarily restrictive in requiring all ignition systems to be independent of all other electrical systems. The FAA agrees with respect to reciprocating engines since § 33.37 requires a

dual ignition system or an ignition system of equivalent inflight reliability for reciprocating engines and § 23.903 requires each engine installed on small airplanes to be type certificated under Part 33. However, the FAA disagrees with respect to turbine engines since two separate primary electrical circuits are not required in § 33.69. The rule as adopted is applicable to turbine engines installed on small airplanes only.

Proposal 2–32. One commentator objected to the proposal to add a speed warning device for turbopropeller powered airplanes. The FAA believes that due to the characteristics of turbopropeller powered airplanes that make it desirable to operate at the maximum operating limit speed (V_{MO}/M_{MO}), and the increasing preoccupation of pilots with air traffic and other duties which distract them from continuous monitoring of airspeed instruments overspeed conditions can be a problem. Therefore, to insure early warning and thus to make a major portion of the speed margin available for pilot reaction and recovery maneuvers, the amendment requires that the speed warning device must give effective aural warning (differing distinctively from aural warnings used for other purposes) to the pilots whenever the speed exceeds V_{MO} plus 6 knots or $M_{MO}+0.01$.

It should also be noted that the proposal for § 23.1303(d) has been revised to make it like § 25.1303(a)(1) to allow for an air temperature indicator which provides indications that are convertible to free-air temperature.

Proposal 2–33. No unfavorable comments were received on the proposal to amend § 23.1309. Accordingly, the proposal is adopted without substantive change.

Proposal 2–34. One commentator suggested that proposed §§ 23.1322 and 25.1322 concerning warning, caution, and advisory light be revised. The commentator noted that requiring a blue light for position indication was not always appropriate since blue was difficult to see in direct sunlight but was readily distinguishable in heavily shaded installations. The FAA agrees that blue should not be an established standard applicable to all installations. Therefore proposed §§ 23.1322(d), 25.1322(d), 27.1322(d) and 29.1322(d), concerning blue lights, are withdrawn. Also see Proposal 2–82.

Proposal 2–35. The proposed amendments to §§ 23.1325, 25.1325, and 29.1325 concerning the static pressure sources are related to proposed amendments to § 27.1325 that are contained in Airworthiness Review Program, Notice No. 2: Miscellaneous Proposals (Notice 75–10; 40 FR 10812; March 7, 1975) and in Airworthiness Review Program, Notice No. 5: Equipment and System Proposals (Notice 75–23; 40 FR 23048; May 27, 1975). The proposed amendment to § 27.1325 in Notice 75–10 is being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–23. The proposed amendments to §§ 23.1325, 25.1325, and 29.1325 contained in Notice 75–10 are therefore being deferred until final rulemaking action is taken with respect to the related proposed amendments to § 27.1325. Comments submitted for Proposals 2–35, 2–83, and 2–183 will be considered at that time.

Proposal 2–36. One commentator questioned the proposed lead-in for § 23.1331(b). The commentator interpreted the proposal to mean that each instrument must have independent power sources and noted that the explanation did not indicate this to be intended. The FAA agrees that the proposal is not clear, and the proposal is withdrawn.

Proposal 2–37. The proposed change to § 23.1335 concerning the deletion of the section is related to a proposed amendment to § 23.1335 that is contained in Airworthiness Review Program, Notice No. 5: Equipment and Systems Proposals (Notice 75–23; 40 FR 23048; May 27, 1975). The proposed amendment to § 23.1335 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–23. Comments submitted for Proposal 2–37 will be considered at that time.

Proposal 2–38. No unfavorable comments were received on the proposal to amend § 23.1351. Accordingly, the proposal is adopted without substantive change.

Proposal 2–39. Proposed § 23.1353(f) concerning nickel-cadmium batteries is related to a proposed amendment to § 23.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 23.1353 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–39 will be considered at that time.

Proposal 2–40. For comments related to the proposed amendment of § 23.1385, see Proposal 2–89.

Proposal 2–41. One commentator suggested that proposed § 23.1411(b)(2) be revised to conform to the language in § 25.1411(b)(2). The FAA, however, believes a more specific standard is appropriate for §§ 23.1411 and 27.1411. Therefore, the proposed amendments to §§ 23.1411 and 27.1411 are adopted without substantive change.

Proposal 2–42. One commentator suggested that the proposed change to § 23.1549 be revised to accommodate horizontal scale powerplant instruments. The FAA agrees, and §§ 23.1549, 27.1549 and 29.1549, as adopted, will provide marking standards appropriate to circular, horizontal and vertical scale powerplant instruments.

Proposal 2–43. The proposed change to § 23.1555 concerning the information requirements of usable fuel in a restricted use fuel tank is related to a proposed amendment to § 23.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 23.1555 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–43 will be considered at that time.

Proposal 2–44. The proposed change to § 23.1557 concerning the system voltage marking requirement adjacent to its external power connection is related to a proposed amendment to § 23.1557 that is contained in Airworthiness Review Program, Notice No. 3; Powerplant Proposals (Notice 75–19; 40 FR 21866; May 19, 1975). The proposed amendment to § 23.1557 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–19. Comments submitted for Proposal 2–44 will be considered at that time.

Proposal 2–45. The proposed change to § 23.1581 concerning the Airplane Flight Manual is related to a proposed amendment to § 23.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 23.1581 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related Proposal in Notice 75–25. Comments submitted for Proposal 2–45 will be considered at that time.

Proposal 2–46. The proposed change to § 23.1587(a)(2) is related to proposed amendments to § 23.1587 that were contained in Airworthiness Review Program, Notice 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 23.1587 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–46 will be considered at that time.

Proposal 2–47. One commentator suggested that considering the proposed deletion of §§ 25.45 through 25.75, current § 25.161(e) will need to be amended to replace the reference to § 25.69. The FAA agrees, and § 25.161(e)(1) is amended by striking the reference to § 25.69 and inserting in place thereof a reference to § 25.123(a). In addition, the FAA has found that § 25.201(c)(1) refers to § 25.49(c)(2)(i) that would also be deleted. Therefore, § 25.201(c)(1) as amended strikes the phrase "§ 25.49(c)(2)(1) for reciprocating engine powered airplanes, or in" and the phrase "for turbine engine powered airplanes".

Proposal 2–48. No unfavorable comments were received on the proposed change to strike the words "turbine powered" from § 25.101(a). Accordingly, proposed § 25.101(a) is adopted without substantive change.

No unfavorable comments were received on proposed § 25.101(b) and it is adopted as proposed except that it is clarified to indicate that the 80% relative humidity for reciprocating engines is based on standard atmospheric temperature (the vapor pressure values in the table in proposed § 25.101(b)(2) correspond to 80% relative humidity with a standard atmosphere).

Proposal 2–49. Based on comments received on the proposal to amend § 25.105 and on the related proposals to §§ 25.125, 25.241 and 25.1533(c), and upon further review by the FAA, Proposals 2–49, 2–51, 2–52 and the portion of 2–93 dealing with the new operating limitation requirements for transport category airplanes intended to be used in operations on unpaved runways are withdrawn.

Proposal 2–50. No unfavorable comments were received on the proposal to amend § 25.107. Accordingly, the proposal is adopted without substantive change.

Proposal 2–51. For comments related to the withdrawal of the proposed amendment of § 25.125, see Proposal 2–49.

Proposal 2–52. For comments related to the withdrawal of the proposal to add a new § 25.241, see Proposal 2–49.

Proposal 2–53. No unfavorable comments were received on the proposal to amend § 25.397. Accordingly, the proposal is adopted without substantive change.

Proposal 2–54. For comments related to the proposed amendment of the lead-in of § 25.603, see Proposal 2–11.

Proposal 2–55. No unfavorable comments were received on the proposal to amend § 25.675. Accordingly, the proposal is adopted without substantive change. Also see Proposal 2–13.

Proposal 2–56. No unfavorable comments were received on the proposal to amend § 25.685(a). Accordingly, the proposal is adopted without substantive change. See Proposal 2–109.

Proposal 2–57. No unfavorable comments were received on the proposal to add a new § 25.733(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–58. One commentator questioned whether the proposed § 25.775(e) would require that there be at least two windshield panels in the windshield for each pilot. The intent of the proposal, however, is to provide at least one windshield panel through which at least one pilot could see if vision was lost through another panel.

Proposal 2–59. Proposed § 25.783(g) concerning integral stairs installed in passenger entry doors that qualify as passenger exits is related to a proposed amendment to § 25.783 that is contained in Airworthiness Review Program, Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75–31; 40 FR 29410; July 11, 1975). The proposed amendment to § 25.783(g) contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–31. Comments submitted for Proposal 2–59 will be considered at that time.

Proposal 2–60. The proposed change to § 25.785 is related to a proposed amendment to § 25.785 that is contained in Airworthiness Review Program, Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75–31; 40 FR 29410; July 11, 1975). The proposed amendment to § 25.785 contained in Notice No. 2 is, therefore, being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–31. Comments submitted for Proposal 2–60 will be considered at that time.

Proposal 2–61. No unfavorable comments were received on the proposed new § 25.787(c). However, based on a comment received on Proposal 2–111, this proposal has been revised to avoid any implication that lamps will be required in cargo compartments.

Proposal 2–62. Four of the five comments received were in favor of the proposal for § 25.815 that would provide for the approval of an aisle width of less than 12 inches, but not less than 9 inches, in transport airplanes with a passenger seating capacity of 10 or less if the aisle width is substantiated by necessary tests. One commentator requested that the proposal be withdrawn because it would result in a reduction in the margin of passenger safety. The FAA disagrees. Service experience with aircraft certificated with less than a 12 inch aisle width in the past has been satisfactory.

Moreover, the FAA will not certificate transport category aircraft with less than a 12 inch aisle width unless the Administrator finds by necessary test that the narrower aisle is safe.

The proposal is adopted without change.

Proposal 2–63. The proposed change to § 25.831 concerning the temperature and ventilation controls for the crew compartment is related to a proposed amendment to § 25.831 that is contained in Airworthiness Review Program Notice No. 5: Equipment and Systems Proposals (Notice 75–23; 40 FR 23048, May 27, 1975). The proposed amendment to § 25.831 contained in Notice No. 2 is therefore being deferred until final

rulemaking action is taken with respect to the related proposal in Notice 75–23. Comments submitted for Proposal 2–63 will be considered at that time.

Proposal 2–64. One commentator recommended that proposed § 25.841(b)(1) be revised to make it clear that the pressure relief function may be combined with the regulating valve. The proposal would delete the requirement that one of the pressure relief valves be a pressure regulating valve, but it would still allow such a design. This was specifically covered in Notice 75–10.

One commentator suggested that the language "passenger or crew compartment" in proposed § 25.841(b)(8) be changed to read "occupiable area in the cabin" to ensure that a pressure sensor is located in the lower deck service compartment. The FAA believes the language "occupiable area in the cabin" does not clarify the proposed requirements. The language "passenger and crew compartment" is not limited to the main deck of the airplane, but includes a lower deck service compartment even though this lower deck service compartment may not be occupied during takeoff and landing. For clarification, the parenthetical "(including upper and lower lobe galleys)" has been added to § 25.841(b)(8) as adopted.

Proposal 2–65. The proposed change to § 25.853 concerning the certification requirements necessary to permit smoking in transport category airplanes is related to a proposed amendment to § 25.853 that is contained in Airworthiness Review Program, Notice No. 8: Aircraft, Engine and Propeller Airworthiness, and Procedural Proposals (Notice 75–31, 40 FR 29410; July 11, 1975). The proposed amendment to § 25.853 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–31. Comments submitted for Proposal 2–65 will be considered at that time.

Proposal 2–66. No unfavorable comments were received on the proposal to amend § 25.933(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2–67. A commentator suggested that a cross-reference to § 25.143 should be added to proposed § 25.941. The FAA agrees that the pilot strength limits now set forth in § 25.143 should be referenced in § 25.941 in order to define appropriately what constitutes "exceptional strength on the part of the pilot". Accordingly, a paragraph (c) has been added to proposed § 25.941 for that purpose.

Proposal 2–68. Two commentators agreed with the intent of the proposed § 25.951(a) concerning fuel system design and operation of the auxiliary power unit (APU) but requested that it be withdrawn to allow time to review other Part 25 provisions for applicability to APU installations. The FAA does not believe that a further review of Part 25 should in this case, delay completion of this rulemaking action. However, if the FAA determines that the language "auxiliary power unit" should be specifically set forth in other provisions to avoid misinterpretation, the FAA will take action to clarify these provisions.

One commentator stated that the fuel system for an APU operated on the ground would be unnecessarily subject to the same requirement as the engine fuel system. The FAA does not agree that this is necessary. If certain operating conditions are the same for both the engine fuel system and the APU fuel system, the FAA believes that the requirements during such periods should be the same. The proposal is therefore adopted without substantive change.

Proposal 2–69. One commentator suggested that the language "proof and ultimate factors" in the proposal for new paragraphs (d) and (e) of § 25.979 be revised to be consistent with § 25.301. The FAA agrees that the terminology should be consistent and the section as adopted is reworded to use the term ultimate load.

One commentator questioned whether the design criteria for the pressure fueling system was applicable to fuel tanks and fuel tank vents. The proposed amendment to § 25.979 was not intended to apply to fuel tanks and vents. The section as adopted has been revised to make this clear.

Proposal 2–70. Several commentators questioned the meaning of the term "quick actuation drain valve" in proposed § 25.999(b)(3). The FAA agrees that the term may be subject to misinterpretation and that the provision is complete without the words "quick actuation".

One commentator asserted that the proposed requirement in § 25.999(b)(3) that the drain valve not be damaged in the event of a landing with landing gear retracted was not a proper design specification since damage was beyond the control of the manufacturer. The FAA agrees that the language "so that it will not be damaged" is not proper for this requirement, but the FAA believes that the valve, the location of the valve, or both, can be designed to prevent fuel spillage, assuming that a landing is made with the landing gear retracted. The section as adopted has been revised to clarify this intent.

Proposal 2–71. One commentator suggested that proposed § 25.1027(d) be revised to limit the design consideration to sludge or other foreign matter entering the feathering system from the oil tank. The FAA disagrees. Design consideration and flexibility should not be limited to preventing entry of material into the feathering system. All sources of sludge and foreign matter must be considered since the purpose of the regulation is the safe operation of the propeller feathering system. The proposal, therefore is adopted without substantive change.

Proposal 2–72. One commentator suggested that the word "critical" be added before the language "ground, water, and flight operating conditions" in the proposal for § 25.1041, but no reason was given. As noted in the explanation to this proposal, § 25.1041 contains a general cooling requirement, while §§ 25.1043 and 25.1045 are more specific with respect to the type of operating conditions which must be considered during tests. Critical conditions are included in the test requirements of §§ 25.1043 and 25.1045. However, the FAA believes that cooling provisions must be adequate under all ground, water, and flight operating conditions.

Proposal 2–73. No unfavorable comments were received on the proposal to amend § 25.1091(c)(2). Accordingly, the proposal is adopted without substantive change.

Proposal 2–74. One commentator agreed with the proposal for § 25.1093 but suggested that the proposal be changed to agree with the format of the previous paragraphs. The FAA agrees, and the proposal as adopted has been structured the same as the previous paragraphs.

Proposal 2–75. One commentator objected to the proposed lead-in for § 25.1125 that limited the applicability of the section to reciprocating engines. The FAA does not believe that the requirements of this section are applicable to other than reciprocating engine powered airplanes. While some early turbine powered airplanes have had an ejector installation in the exhaust stream to pull cooling air through the nacelle, the FAA does not consider this to be an exhaust heat exchanger within the meaning of the language of § 25.1125. Therefore, the proposed lead-in for § 25.1125 is adopted without substantive change.

Proposed § 25.1125(a)(3) is withdrawn. For a discussion of the withdrawal, see Proposal 2–29.

Proposal 2–76. A commentator stated that the phrase "automatically controlled with relation to the amount of power produced by the engine" in proposed § 25.1143(d) is not appropriate for all fluid injection systems. The FAA agrees that the phrase is not appropriate for certain turbine engine powered airplanes and that further revision of § 25.1143(d) should be considered. Proposed § 25.1143(d) has therefore been withdrawn for further study.

No unfavorable comment was received concerning proposed § 25.1143(e) and this paragraph has been adopted without substantive change.

Proposal 2–77. No unfavorable comments were received on the proposal to add a new § 25.1167. Accordingly, the proposal is adopted without substantive change.

Proposal 2–78. No unfavorable comments were received on the proposal to amend § 25.1197(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2–79. One commentator suggested that proposed § 25.1303(a)(2) be revised to clarify the method of clock indication which would be permitted under the regulation. The FAA agrees that the intent of the proposal was only to recognize the development of accurate digital clocks and that the minimum information presented should be the same. Proposed §§ 25.1303(a)(2) and 29.1303(d) as adopted are revised to make this clear.

Proposal 2–80. Several commentators suggested that the proposed change to § 25.1305 be revised to except anti-detonant injection (ADI) systems from the powerplant instrument proposal for fluid augmentation systems. The commentators expressed the opinion that the proposal for § 25.1143(d) concerning automatic controls for fluid injection systems (other than fuel) eliminated the need for a powerplant instrument for the ADI system. The FAA believes that the flight crew should be able to monitor the proper functioning of any fluid system that is used for thrust or power augmentation and the section as adopted is applicable to ADI systems. However, the section has been clarified to ensure application only to fluids systems that are used for thrust or power augmentation.

Proposal 2–81. No unfavorable comments were received on the proposal to amend § 25.1309. Accordingly, the proposal is adopted without substantive change.

Proposal 2–82. One commentator questioned the proposed color standardization of warning, caution, and advisory lights in new § 25.1322. The commentator stated "arbitrary standards for specific light colors cannot always be stated" because of the design objective to minimize red lights that require immediate crew action and of the need to consider past experience, test, crew acceptance, and the specific application. The FAA agrees that considerations other than the need for standardization of light colors may dominate in special circumstances, and the section as adopted provides for approval by the Administrator of light colors that are different than the standard. As stated by the commentator and in the section as adopted, a design objective is to have red warning lights only if a hazard is to be indicated which may require immediate corrective action.

One commentator noted that the language "warning light" is used in other sections of the regulations, such as § 25.812(e)(2), and a hazard which may require immediate corrective action will not be indicated. The FAA does not agree; the light noted in § 25.812(e)(2) should be red in future designs unless otherwise approved by he Administrator. The FAA believes that in other sections, if the language "warning light" is used, it is consistent with proposed new § 25.1322. However, if the language "warning light" is determined to be not generally applicable, later rulemaking action can be instituted.

One commentator suggested a clarification of the lead-in of the proposal to limit its applicability to lights installed in the cockpit as indicated in the explanation to the proposal. The FAA agrees, and the lead-ins of §§ 23.1322, 25.1322, 27.1322, and 29.1322 have been clarified.

Also see Proposal 2–34 for a discussion of the withdrawal of the blue light proposal.

Proposal 2–83. For comments related to the deferral of proposed § 25.1325(g), see Proposal 2–35.

Proposal 2–84. The proposed change to § 25.1329 concerning the redesignation of § 25.1329 as § 25.1311 and the addition of provisions for automatic flight control systems is related to a proposed amendment to § 25.1329 that is contained in Airworthiness Review Program, Notice No. 5: Equipment and Systems Proposals (Notice 75–23; 40 FR 23048, May 27, 1975). The proposed amendment to § 25.1329 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–23. Comments submitted for Proposal 2–84 will be considered at that time.

Proposal 2–85. Proposed § 25.1331(a)(2) concerning instruments using a power supply is related to proposed amendments to §§ 25.1331 and 25.1333 that are contained in Airworthiness Review Program, Notice No. 5: Equipment and Systems Proposals (Notice 75–23; 40 FR 23048; May 27, 1975). The proposed amendment to § 25.1331(a)(2) contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposals in Notice 75–23. Comments submitted for Proposal 2–85 will be considered at that time.

Proposal 2–86. Proposed § 25.1337(a) concerning auxiliary power unit instrument lines is related to a proposed amendment to § 25.1337(a) that is contained in Airworthiness Review Program, Notice No. 3: Powerplant Proposals (Notice 75–19; 40 FR 21866; May 19, 1975). The proposed amendment to § 25.1337(a) contained in Notice No. 2 is therefore deferred until final rulemaking action is taken with respect to the

related proposal in Notice 75–19. Comments submitted for Proposal 2–86 will be considered at that time.

Proposal 2–87. Proposed § 25.1353(c)(5) is related to a proposed amendment to § 25.1585 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 25.1353(c)(5) contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–87 will be considered at that time.

Proposal 2–88. No unfavorable comments were received on the proposal to amend § 25.1355(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–89. Several commentators suggested that the list of factors to consider for locating forward and rear position lights in proposed §§ 23.1385, 25.1385, 27.1385, and 29.1385 was incomplete.

Two commentators, also suggested that proposed §§ 23.1385(c) and 25.1385(c) be revised to permit a new position light to be installed on each wing tip. The FAA agrees that further study is necessary to develop factors of general applicability for position lights on all aircraft but that a rear position light as far aft as practical on each wing tip of an airplane is a reasonable alternative location. Accordingly, proposed §§ 23.1385(c) and 25.1385(c) have been revised. The proposals concerning the list of factors to be considered for locating forward and rear position lights in § 25.1385 and paralleled in proposed §§ 23.1385, 27.1385, and 29.1385 are withdrawn. However, the deletion of the passing light requirement from current § 25.1385(e) will be made.

Proposal 2–90. One commentator asserted that proposed new § 25.1403 was an operating requirement, not an airworthiness requirement and therefore was not appropriate for Part 25. Although a similar requirement currently exists in § 121.341(b), the FAA believes that such a requirement should be applicable to all newly certificated transport category airplanes.

Two commentators pointed out that the proposal differs from § 121.341(b) in that the proposal was not limited to the area of the wings that are critical from the standpoint of ice accumulation. The FAA agrees, and the section as adopted has been revised accordingly.

A comment was also received that expressed the belief that under the proposal, illumination or other means of ice detection would not be necessary if the wing was shown to have acceptable ice accumulation characteristics. The FAA does not agree. Unless an operating limitation prohibits operations at night in known or forecast icing conditions, the means set forth are required.

Proposal 2–91. Several commentators said that the proposed change to § 25.1439(b)(2)(ii) concerning standards for masks and eye coverings was premature in view of the current testing being conducted on this type of equipment by the FAA. The FAA agrees that this proposed amendment is premature, and new standards are being considered for a later rulemaking action. The proposed change to § 25.1439(b)(2)(ii) is therefore withdrawn.

No favorable comments were received on the proposal to amend paragraph (a) of § 25.1439. Accordingly, the proposal is adopted without substantive change.

Proposal 2–92. No unfavorable comments were received on the proposal to amend § 25.1515. Accordingly, the proposal is adopted without substantive change.

Proposal 2–93. No unfavorable comments were received on the proposal to amend the heading of § 25.1533 and on the proposal to amend § 25.1533(a). Accordingly, this amendment is adopted without substantive change. For comments related to the withdrawal of the proposed new § 25.1533(c), see Proposal 2–49.

Proposal 2–94. The proposed change to § 25.1549 concerning the marking requirements for powerplant instruments is related to a proposed amendment to § 25.1549 that is contained in Airworthiness Review Program, Notice No. 3: Powerplant Proposals (Notice 75–19; 40 FR 21866; May 19, 1975). The proposed amendment to § 25.1549 contained in Notice No. 2 is therefore deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–19. Comments submitted for Proposal 2—94 will be considered at that time.

Proposal 2–95. One commentator took exception to the proposed deletion of the requirement for marking fuel and oil tank capacities at the filler openings in § 25.1557(b). The FAA believes this method of providing the usable fuel tank capacity and the oil tank capacity is no longer necessary. The pilot has the fuel quantity gage and the Airplane Flight Manual, and the servicing personnel usually have no interest in the usable fuel tank capacity. The determination of oil level in oil tanks is usually accomplished with the dipstick. Accordingly, the proposal is adopted without substantive change.

Proposal 2–96. The proposed change to § 25.1581 concerning the Airplane Flight Manual is related to proposed amendment § 25.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 25.1581 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–96 will be considered at that time.

Proposal 2–97. No unfavorable comments were received on the proposal to amend § 25.1583. Accordingly, the proposal is adopted without substantive change.

Proposal 2–98. The proposed change to § 25.1587 concerning performance information is related to a proposed amendment to § 25.1587 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposal amendment to § 25.1587 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–98 will be considered at that time.

Proposal 2–99. Two commentators questioned the applicability of proposed § 27.25(c) concerning a total weight that was greater than the maximum weight established under § 27.25(a) and noted that a clarification of the applicable flight requirements was needed. The FAA agrees that proposed § 27.25(c) should be clarified. Proposed §§ 27.25(c) and 29.25(c) are intended to provide only a total weight standard for approving the rotorcraft structure for rotorcraft that will be operated under Part 133. Proposed §§ 27.25(c) and 29.25(c) as adopted have been revised to clarify this intent.

Proposal 2–100. Proposed § 27.65(a)(2)(i) concerning climb gradients for rotorcraft other than helicopters is related to a proposed new § 27.1587(b)(3) that is contained in Airworthiness Review Program, Notice No. 2: Miscellaneous Proposals (Notice 75–10; 40 FR 10802; March 7, 1975). The proposed amendment to § 27.1587 contained in Notice 75–10 is being deferred; see Proposal 2–140. Therefore, the proposed amendment to § 27.65 contained in Notice 75–10 is also deferred until final rulemaking action is taken with respect to the related proposal for § 27.1587. Comments submitted for Proposal 2–100 will be considered at that time.

Proposal 2–101. No unfavorable comments were received on the proposal to amend § 27.141. Accordingly, the proposal is adopted without substantive change.

Proposal 2–102. No unfavorable comments were received on the proposal to amend § 27.173(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2–103. No unfavorable comments were received on the proposal to amend § 27.175(d)(2)(iv). Accordingly, the proposal is adopted without substantive change.

Proposal 2–104. No unfavorable comments were received on the proposal to amend § 27.321(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2–105. No unfavorable comments were received on the proposal to amend § 27.339. Accordingly, the proposal is adopted without substantive change.

Proposal 2–106. Two commentators suggested that the limit pilot torque for rotorcraft twist controls in proposed §§ 27.397(b)(2) and 29.397(b)(2) should be 80 times the radius (R) in inches instead of 133 inch-pounds, as proposed. The FAA agrees that the pilot torque load requirements should be a function of the radius (R). Also the FAA does not expect the radius (R) of any twist control installed on any rotorcraft type certificated in the future to be greater than 133/80 inches. Therefore, the proposals as adopted revise the limit pilot torque load to 80R inch-pounds.

Proposal 2–107. No unfavorable comments were received on the proposal to add a new § 27.563. Accordingly, the proposal is adopted without substantive change.

Proposal 2–108. No unfavorable comments were received on the proposal to amend § 27.603. Accordingly, the proposal is adopted without substantive change.

Proposal 2–109. One commentator disagreed with proposed §§ 27.685(a) and 29.685(a) that would require the consideration of the effects of the freezing of moisture on control systems since §§ 27.685(a) and 29.685(a) currently require that control systems be designed to prevent jamming. While the explanation for this proposal indicated that the freezing of moisture was a common cause of control jamming, the proposal is also directed at preventing chafing and interference caused by the freezing of moisture. Accordingly, the proposals are adopted without substantive change.

Proposal 2–110. No unfavorable comments were received on the proposal to add a new § 27.733(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–111. Based on a comment received, the proposed change to § 27.787 has been revised to avoid any implication that lamps will be required in cargo compartments.

Proposal 2–112. No unfavorable comments were received on the proposal to add a new § 27.801. Accordingly, the proposal is adopted without substantive change.

Proposal 2–113. Several commentators stated that the ditching emergency exit standards proposed for §§ 27.807(d) and 29.807 should not be applicable to all rotorcraft. The commentators noted that the new standards would unnecessarily penalize rotorcraft that would never be involved in a ditching situation. The FAA agrees that certain rotorcraft may not operate in areas where ditching is a concern. Compliance with the ditching emergency exit standards should not be required for all rotorcraft during type certification. Therefore, the proposals as adopted have been revised to make it applicable only to rotorcraft for which ditching certification is requested. The overhead hatch requirements proposed in new §§ 27.807(d)(2) and 29.807(d)(3) are withdrawn because of the possible hazards associated with a turning main rotor. In addition, the reference in proposed § 27.807(d) to § 27.807(a) has been deleted as unnecessary, and the reference in proposed § 29.807(d) to § 29.807(c) has been deleted as inappropriate.

Proposal 2–114. For comments related to the proposed amendment of § 27.853, see Proposal 2–18.

Proposal 2–115. Upon further FAA review proposed §§ 27.865(a) and 29.865(a) concerning external load attaching means have been revised to preclude the necessity of considering the application of an external load at angles that will not be obtained in service. One commentator objected to the requirement for a manual mechanical control for the quick-release device. The commentator stated that this requirement was too restrictive due to the other standby electrical systems available. The FAA does not agree. Contrary to the commentator's contention the reliability of controls other than manual mechanical controls have not been sufficiently substantiated to permit their use in place of an manual mechanical control.

Proposal 2–116. One commentator objected to the proposals to add new standards concerning turbine engine installations to §§ 27.903 and 29.903 that would be substantively identical to proposed § 23.903(b). The commentator requested that the proposals be withdrawn since helicopter service experience does not indicate that such a standard is necessary and due consideration has not been given to the differences between helicopter and airplane engine control systems. The FAA disagrees. While there are differences between helicopter and airplane engine installations, the FAA believes that the proposals would provide general design requirements relating to engine operating limitations and engine installation requirements and that these engine installation requirements should be paralleled in Parts 23, 27, and 29. Also see Proposal 2–19.

Proposal 2–117. For comments concerning proposed § 27.917(d), see Proposal 2–163.

Proposal 2–118. The proposed change to § 27.927 concerning the torque transmission test is related to a proposed amendment to § 27.927 that is contained in Airworthiness Review Program, Notice No. 3: Powerplant Proposals (Notice 75–19; 40 FR 21866; May 19, 1975). The proposed amendment to § 27.927 contained in Notice No. 2 is therefore deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–19. Comments submitted for Proposal 2–118 will be considered at that time.

Proposal 2–119. No unfavorable comments were received on the proposal to add a new § 27.939(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–120. No unfavorable comments were received on the proposal to amend § 27.977. Accordingly, the proposal is adopted without substantive change.

Proposal 2–121. Two commentators objected to the proposals to amend §§ 27.999(b) and 29.999(b) to require the installation of quick actuation type drain valves that are readily accessible, which can be easily opened and closed, and is either located or protected so that it will not be damaged in the event of a landing with landing gear retracted. The commentators stated that the requirement to include crash landing consideration is not considered appropriate since there are a great number of other areas which must be covered in crash landing conditions. The proposals, however, would require that the fuel system drain valves be either located or protected so that it will not be damaged in the event of a landing with landing gear retracted. There are no requirements in the proposal for consideration of crash landing conditions.

In consideration of comments discussed under Proposals 2–26, and 2–70, §§27.999(b)(3)(ii) and 29.999(b)(3)(ii), as adopted, have been clarified to more specifically provide a design consideration.

See Proposals 2–26 and 2–70.

Proposal 2–122. No unfavorable comments were received on the proposal to amend § 27.1043(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–123. No unfavorable comments were received on the proposal to add a new § 27.1093(c). The proposal as adopted has been editorially changed to agree with the format of the current section.

Proposal 2–124. No unfavorable comments were received on the proposal to add a new § 27.1123. Accordingly, the proposal is adopted without substantive change.

Proposal 2–125. No unfavorable comments were received on the proposal to add a new § 27.1143(d), and the proposal is adopted without substantive change. However, the heading of § 27.1143 has been amended to reflect the contents of the section after the adoption of a new paragraph (d).

Proposal 2–126. No unfavorable comments were received on the proposal to amend § 27.1185. Accordingly, the proposal is adopted without substantive change.

Proposal 2–127. For comments related to proposed amendment of § 27.1322, see Proposals 2–34 and 2–82.

Proposal 2–128. The proposed change to § 27.1325 concerning the static pressure sources is related to a proposed amendment to § 27.1325 that is contained in Airworthiness Review Program, Notice No. 5: Equipment and Systems. Proposals (Notice 75–23; 40 FR 23048; May 27, 1975). The proposed amendment to § 27.1325 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–23. Comments submitted for Proposal 2–128 will be considered at that time.

Proposal 2–129. The proposal for a new § 27.1329 concerning the standards for automatic pilot systems is related to a proposed new § 27.1311 that is contained in Airworthiness Review Program, Notice No. 5: Equipment and System Proposals (Notice 75–23; 40 FR 23048; May 27, 1975). The proposal for § 27.1329 contained in Notice No. 2 is therefore being deferred until final rulemaking is taken with respect to the related proposal in Notice 75–23. Comments for Proposal 2–129 will be considered at that time.

Proposal 2–130. **No unfavorable comments were received on the proposal to amend § 27.1351. Accordingly, the proposal is adopted without substantive change.**

Proposal 2–131. Proposed § 27.1353(f) concerning nickel-cadmium batteries is related to a proposed amendment to § 27.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 27.1353(f) contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–131 will be considered at that time.

Proposal 2–132. **For comments related to the proposed amendment of § 27.1385 and the withdrawal of the proposal, see Proposal 2–89.**

Proposal 2–133. No unfavorable comments were received on the proposal to amend § 27.1411. Accordingly, the proposal is adopted without substantive change.

Proposal 2–134. No unfavorable comments were received on the proposal to amend § 27.1415(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2–135. The proposed change to § 27.1545 concerning the V_{ss} requirements is related to a proposed amendment to § 27.1505 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 27.1545 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–135 will be considered at that time.

Proposal 2–136. For comments related to the proposed amendment of § 27.1549, see Proposal 2–42.

Proposal 2–137. No unfavorable comments were received on the proposal to amend § 27.1555(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–138. No unfavorable comments were received on the proposal to amend § 27.1557(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–139. The proposed change to § 27.1581 concerning the Airplane Flight Manual is related to a proposed amendment to § 27.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 27.1581 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–139 will be considered at that time.

Proposal 2–140. The proposed change to § 27.1587 is related to a proposed amendment to § 27.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 27.1587 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–140 will be considered at that time.

Proposal 2–141. One commentator suggested that the proposed new § 29.25(c) provisions be limited to category B rotorcraft. However no reason for the suggestion was stated. The FAA knows of no reason why the proposed provisions should be limited to category B rotorcraft. One commentator questioned the applicability of proposed new § 29.25(c) and noted that a clarification of the applicable flight requirements was needed. For discussion of this and other comments related to the proposed new § 29.25(c), see Proposal 2–99.

Proposal 2–142. No unfavorable comments were received on the proposal to amend § 29.63. Accordingly, the proposal is adopted without substantive change.

Proposal 2–143. Several commentators recommended that § 29.67(a)(1) be revised by adding the term "at V_{TOSS}" following the words "feet per minute", and by deleting the phrase "without ground effect". Although paragraph (a)(1)(iv) of § 29.67 as proposed defines the speed to be used in meeting the climb requirements of § 29.67(a)(1) as the takeoff safety speed, the FAA does not believe that the term "V_{TOSS}" is appropriate. Also the FAA does not agree that the phrase "without ground effect" should be deleted from § 29.67(a)(1). The FAA requires that all climb performance be conducted outside the influence of ground effect. Accordingly, the proposal is adopted without substantive change.

Proposal 2–144. No unfavorable comments were received on the proposal to amend § 29.71. Accordingly, the proposal is adopted without substantive change.

Proposal 2–145. No unfavorable comments were received on the proposal to amend § 29.75(b)(2). Accordingly, the proposal is adopted without substantive change.

Proposal 2–146. No unfavorable comments were received on the proposal to amend § 29.141. Accordingly, the proposal is adopted without substantive change.

Proposal 2–147. No unfavorable comments were received on the proposal to amend § 29.173(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2–148. No unfavorable comments were received on the proposal to amend § 29.175(d)(2)(iv). Accordingly, the proposal is adopted without substantive change.

Proposal 2–149. For comments related to the proposed amendment of § 29.397, see Proposal 2–106.

Proposal 2–150. No unfavorable comments were received on the proposal to add a new § 29.563. Accordingly, the proposal is adopted without substantive change.

Proposal 2–151. No unfavorable comments were received on the proposal to amend § 29.603. Accordingly, the proposal is adopted without substantive change.

Proposal 2–152. For comments related to the proposed amendment of § 29.685(a), see Proposal 2–109.

Proposal 2–153. No unfavorable comments were received on the proposal to add a new § 29.733(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–154. The proposed change to § 29.783 concerning the requirements applicable to "airstair doors" in transport category rotorcraft is related to proposed amendments to § 25.783 that are contained in Airworthiness Review Program, Notice No. 2: Miscellaneous Proposals (Notice 75–10; 40 FR 10802; March 7, 1975) and in Airworthiness Review Program, Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75–31; 40 FR 29410; July 11, 1975). The proposed amendment to § 25.783 contained in Notice 75–10 is being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–31. The proposed amendment to § 29.783 contained in Notice 75–10 is therefore being deferred until final ruelmaking action is taken with respect to the related proposal for § 25.783. Comments submitted for Proposal 2–154 will be considered at that time.

Proposal 2–155. No unfavorable comments were received on the proposed new § 29.787(d). However, based on a comment received on Proposal 2–111, this proposal has been revised to avoid any implication that lamps will be required in cargo compartments.

Proposal 2–156. No unfavorable comments were received on the proposal to add a new § 29.801. Accordingly, the proposal is adopted without substantive change.

Proposal 2–157. For comments related to the proposed amendment § 29.807, see Proposal 2–113.

Proposal 2–158. No unfavorable comments were received on the proposal to add a new § 29.813(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–159. One commentator objected to the proposed change to § 29.815 for the same reasons as presented for the proposed change to § 25.815. The discussion of § 25.815 in Proposal 2–62 deals with this comment.

Proposal 2–160. For comments related to the proposed amendment of § 29.853, see Proposal 2–18.

Proposal 2–161. For comments related to the proposed new § 29.865, see Proposal 2–115.

Proposal 2–162. No unfavorable comments were received on the proposal to amend § 29.903(c)(1). Accordingly, the proposal is adopted without substantive change. For comments related to the proposal to add new standards concerning turbine engine installation, see Proposals 2–19 and 2–116.

Proposal 2–163. The only public comment received in response to proposed §§ 27.917-(d) and 29.917(a) recommended that the present language in § 29.917(a) be used but gave no reason for the recommendation. The FAA believes that there should be a positive description of the cooling fans that must be considered as part of the rotor drive system. Accordingly, the proposals are adopted without substantive change.

Proposal 2–164. The proposed change to § 29.927 concerning the torque transmission test time is related to a proposed amendment to § 29.927 that is contained in Airworthiness Review Program, Notice No. 8: Aircraft, Engine, and Propeller Airworthiness, and Procedural Proposals (Notice 75–31; 40 FR 29410, July 11, 1975). The proposed amendment to § 29.927 contained in Notice No. 2 is therefore deferred until final rulemaking section is taken with respect to the related proposal in Notice 75–31. Comments submitted for Proposal 2–164 will be considered at that time.

Proposal 2–165. No unfavorable comments were received on the proposal to amend § 29.931. Accordingly, the proposal is adopted without substantive change.

Proposal 2–166. No unfavorable comments were received on the proposal to add a new § 29.939(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–167. No unfavorable comment was received on the proposal to amend § 29.951(a). Accordingly, the proposal is adopted without substantive change. Also see proposal 2–68.

Proposal 2–168. No unfavorable comments were received on the proposal to amend § 29.997. Accordingly, the proposal is adopted without substantive change.

Proposal 2–169. Based on comments concerning proposed changes to § 25.979, proposed new paragraphs (d) and (e) of § 29.979 have also been revised. See Proposal 2–69 for a discussion of the amendment to § 25.979.

Proposal 2–170. One commentator objected to the proposal to § 29.999 on the basis that the helicopter accident records do not show "any great number due to operators not draining fuel sumps." The FAA believes that this low accident rate due to water contamination in the fuel exists because most helicopters already use quick actuation drain valves.

On commentator questioned the need for proposed § 29.999(b) noting that current § 29.971(d) appears to have the same requirement. The FAA agrees that current § 29.971(d) would be redundant for fuel tank sump drains and has therefore deleted the standards for the fuel tank slump drain in § 29.971(d).

The fuel drain standards in § 29.999(b) as proposed are applicable to each drain required by § 29.999(a) including the drains prescribed in § 29.971, but to avoid misinterpretation the section as adopted is clarified to specifically note the fuel tank sump drains prescribed in § 29.971.

Also see Proposals 2–26, 2–70, and 2–121.

Proposal 2–171. One commentator stated that proposed § 29.1041(a) should be revised to except "ground use only" auxiliary power units (APU's). The FAA disagrees. APU's that are permitted to operate only on the ground have inadvertently continued to operate in flight. Safe operation of APU's requires consideration of ground, water, and flight operating conditions. The proposal is therefore, adopted without substantive change.

Proposal 2–172. No unfavorable comments were received on the proposals to amend § 29.1043(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–173. No unfavorable comments were received on the proposal to add a new § 29.1093(c). The proposal as adopted has been editorially changed to agree with the format of the current section.

Proposal 2–174. For comments related to the proposed amendment of § 29.1125, see Proposals 2–29 and 2–75.

Proposal 2–175. No unfavorable comment was received on the proposal to amend § 29.1143 and the proposal is adopted without substantive change. However, the heading of § 29.1143 has been amended to reflect the contents of the section after the addition of a new paragraph (e).

Proposal 2–176. No unfavorable comments were received on the proposal to amend § 29.1165(f). Accordingly, the proposal is adopted without substantive change.

Proposal 2–177. Two commentators objected to the selective use of Part 33 requirements in the proposal for a new § 29.1167 that would provide substantiation requirements for accessory gearboxes that are not certificated as part of an engine. The FAA proposed to amend Part 29 like Part 25 for consistency. The FAA now believes that the proposed new § 29.1167 is inappropriate in view of the requirements to substantiate the rotor drive system including gearboxes under the rotor drive system endurance test requirements. Therefore, proposed new § 29.1167 is withdrawn.

Proposal 2–178. No unfavorable comments were received on the proposal to amend § 29.1189(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2–179. No unfavorable comments were received on the proposal to amend § 29.1197(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2–180. For comments related to the proposed amendment of § 29.1303(d), see Proposal 2–79.

Proposal 2–181. No unfavorable comments were received on the proposal to amend § 29.1307. Accordingly, the proposal is adopted without substantive change.

Proposal 2–182. For comments related to proposed amendment of § 29.1322, see Proposals 2–34 and 2–82.

Proposal 2–183. For comments related to the deferral of proposed § 29.1325, see Proposal 2–35.

Proposal 2–184. The proposed change to § 29.1329 concerning automatic pilot systems is related to a proposed new § 29.1311 that is contained in Airworthiness Review Program, Notice No. 5: Equipment and Systems Proposals (Notice 75–23; 40 FR 23048; May 27, 1975)). The proposal for § 29.1329 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–23. Comments submitted for Proposal 2–184 will be considered at that time.

Proposal 2–185. The proposed change to § 29.1337 concerning the auxiliary power unit instrument lines is related to a proposed amendment to § 29.1337 that is contained in Airworthiness Review Program, Notice No. 3: Powerplant Proposals (Notice 75–19; 40 FR 21866, May 19, 1975). The proposed amendments to § 29.1337 contained in Notice No. 2 is therefore deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–19. Comments submitted for Proposal 2–185 will be considered at that time.

Proposal 2–186. Proposed § 29.1353(c)(5) concerning nickel-cadium batteries is related to a proposad amendment to § 29.1585 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 29.1353(c)(5) contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–186 will be considered at that time.

Proposal 2–187. For comments related to the proposed amendment of § 29.1385 and the withdrawal of the proposal, see Proposal 2–89.

Proposal 2–188. The proposal for § 29.1545 concerning the V_{so} requirements is related to a proposed amendment to § 29.1505 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 29.1545 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–188 will be considered at that time.

Proposal 2–189. For comments related to the proposed amendment of § 29.1549, see Proposal 2–42.

Proposal 2–190. No unfavorable comments were received on the proposal to amend § 29.1555(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–191. No unfavorable comments were received on the proposal to amend § 29.1557(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–192. The proposed change to § 29.1581 concerning the Airplane Flight Manual is related to a proposed amendment to § 29.1581 that is contained in Airworthiness Review Program, Notice No. 6: Flight Proposals (Notice 75–25; 40 FR 24664; June 9, 1975). The proposed amendment to § 29.1581 contained in Notice No. 2 is therefore being deferred until final rulemaking action is taken with respect to the related proposal in Notice 75–25. Comments submitted for Proposal 2–192 will be considered at that time.

Proposal 2–193. No unfavorable comments were received on the proposal to amend § 31.1. Accordingly, the proposal is adopted without substantive change.

Proposal 2–194. No unfavorable comments were received on the proposal to amend §§ 31.11 and 31.20. Accordingly, the proposal is adopted without substantive change.

Proposal 2–195. No unfavorable comment was received on the proposal to add a new § 31.14 concerning weight limits of manned free balloons. Therefore, the section is adopted without substantive change.

Proposal 2–196. No unfavorable comments were received on the proposal to amend § 31.45. Accordingly, the proposal is adopted without substantive change.

Proposal 2–197. No unfavorable comments were received on the proposal to add a new § 31.46. Accordingly, the proposal is adopted without substantive change.

Proposal 2-198. No unfavorable comments were received on the proposal to amend § 31.63. Accordingly, the proposal is adopted without substantive change.

Proposal 2-199. No unfavorable comments were received on the proposal to amend § 31.85. Accordingly, the proposal is adopted without substantive change.

Proposal 2-200. No unfavorable comments were received on the proposal to amend § 33.1. Accordingly, the proposal is adopted without substantive change.

Proposal 2-201. No unfavorable comments were received on the proposal to amend § 35.1. Accordingly, the proposal is adopted without substantive change.

Proposal 2-202. No unfavorable comments were received on the proposal to amend § 35.39. Accordingly, the proposal is adopted without substantive change.

Proposal 2-203. No unfavorable comments were received on the proposal to amend § 35.41(e). Accordingly, the proposal is adopted without substantive change.

Proposal 2-204. No unfavorable comments were received on the proposal to amend § 35.45(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2-205. No unfavorable comments were received on the proposal to amend § 91.14. Accordingly, the proposal is adopted without substantive change.

Proposal 2-206. No unfavorable comments were received on the proposal to amend § 91.21(a). Accordingly, the proposal is adopted without substantive change.

Proposal 2-207. One commentator suggested that the proposed change to § 91.33(d)(6) concerning clock requirements should use the language of § 121.305. The FAA believes that a standard should be specified in § 91.33(d)(6) for digital clocks and the proposal as adopted provides a specific standard. See Proposal 2-79.

Proposal 2-208. The intent of the proposed new § 91.193(g) is to require protective breathing equipment that would meet the standards proposed for § 25.1439(b) on certain airplanes operated under Part 91 Subpart D. Based on the current testing being conducted on this type of equipment, the FAA is developing new standards for a later rulemaking action. The proposal for § 25.1439(b)(2)(ii) is being withdrawn (See Proposal 2-91). Therefore, the FAA believes that the proposal for § 91.193 is premature, and the proposal is withdrawn.

Proposal 2-209. Although no unfavorable comment was received on the proposed revision of § 91.209, the FAA believes that revision of similar ice protection provision in § 135.85 may be necessary. Amendments to §§ 91.209 and 135.85 should be considered together. Therefore, the proposed change to § 91.209 is withdrawn.

Proposal 2-210. No unfavorable comments were received on the proposal to amend § 121.171(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2-211. No unfavorable comments were received on the proposal to amend § 121.199. Accordingly, the proposal is adopted without substantive change.

Proposal 2-212. No unfavorable comments were received on the proposal to amend §§ 121.331(b) and 121.333(b). Accordingly, the proposal is adopted without substantive change.

Proposal 2-213. The intent of proposed § 121.337(d) is to require protective breathing equipment that would meet the proposed requirements of § 25.1439(b) installed in certain airplanes operated under Part 121. However, proposed § 25.1439(b)(2)(ii) is withdrawn in this notice. Based on the current testing being conducted on this type of equipment, the FAA is developing new standards for a later rulemaking action. The FAA therefore believes that the proposed change to § 121.337 is premature and the proposal is withdrawn. Also see Proposal 2-91.

Proposal 2-214. No unfavorable comments were received on the proposal to amend § 127.105. Accordingly, the proposal is adopted without substantive change.

Proposal 2-215. No unfavorable comments were received on the proposal to add a new § 127.106. Accordingly, the proposal is adopted without substantive change.

Proposal 2-216. One commentator objected to the proposed amendment to § 133.1. The commentator stated that the proposal specifically eliminates the reference to airworthiness certification rules when, in fact, Subpart D is retained intact except for the standards for external-load attaching means and quick-release devices. The FAA agrees

that reference to airworthiness requirements should not be deleted without other changes to Part 133, and the proposal is withdrawn.

Proposal 2–217. One commentator objected to the proposed amendment to § 133.41 (c)(6). However no reason for the objection was stated. The proposal is therefore adopted herein without substantive change.

Proposal 2–218. One commentator requested that proposed § 133.43(a) be revised to provide for the use of external-load attaching means previously approved under Part 133. The FAA agrees and proposed § 133.43 is revised accordingly.

Proposal 2–219. No unfavorable comments were received on the proposal to amend § 133.45(c). Accordingly, the proposal is adopted without substantive change.

Proposal 2–220. No unfavorable comments were received on the proposal to amend § 135.71(a)(5). Accordingly, the proposal is adopted without substantive change.

Proposal 2–221. Based upon further review by the FAA proposed § 135.165(b)(2) is being withdrawn because contrary to the explanation for the proposal in Notice 75–10, the proposal would result in unjustifiably different standards for transport category airplanes operated under Part 135 and those operated under Part 121.

(Secs. 313(a), 601, 603, 604, and 605 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, 1423, 1424, and 1425); sec. 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

In consideration of the foregoing, and for the reasons stated in Notice 75–10, Parts 21, 23, 25, 27, 29, 31, 33, 35, 91, 121, 127, 133, and 135 of the Federal Aviation Regulations are amended as follows, effective February 1, 1977.

The Federal Aviation Administration has determined that this document does not contain a major proposal requiring preparation of an Inflation Impact Statement under Executive Order 11821 and OMB Circular A–107.

Amendment 33–8

Airworthiness Review Program—Amendment No. 4: Powerplant Amendments

Adopted: March 10, 1977 **Effective: May 2, 1977**

(Published in 42 FR 15034, March 17, 1977)

The purpose of these amendments is to update and improve the airworthiness standards applicable to the type certification of aircraft engines and propellers and of aircraft with respect to the provisions relating to powerplant installations.

These amendments are the fourth in a series of amendments to be issued as part of the Airworthiness Review Program. The following amendments have previously been issued as part of this Airworthiness Review Program:

Title	*FR Citation*
Form number and clarifying revisions.	40 FR 2576; Jan. 14, 1975.
Rotorcraft anticollision lights standards.	41 FR 5290; Feb. 5, 1976.
Miscellaneous amendments.	41 FR 55454; Dec. 20, 1976.

These amendments are based on two Notices of Proposed Rule Making—Notice 75–10 published in the FEDERAL REGISTER on March 7, 1975 (40 FR 10802); and Notice 75–19 published in the FEDERAL REGISTER on May 19, 1975 (40 FR 21866). The amendments based on Notice 75–10 were deferred in the series of amendments titled "Miscellaneous Amendments" (41 FR 55454; Dec. 20, 1976) so that they could be considered in conjunction with the final disposition of certain proposals in Notice 75–19. The discussions of the comments received for the deferred proposals are included under the heading of the related Notice 75–19 proposals.

Interested persons have been afforded an opportunity to participate in the making of these amendments and due consideration has been given to all matter presented. A number of substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and upon further review within the FAA. Except for the minor editorial and clarifying changes and the substantive changes discussed below, these amendments and the reasons for their adoption are the same as those contained in Notices 75–10 and 75–19.

The following discussion is keyed to the like-numbered proposals contained in Notice 75–19:

Proposal 3–1. In commenting on proposed § 1.1, which would add definitions for "Altitude engine" and "Sea level engine," one commentator suggested that current § 91.33(b)(8) should be revised to require a manifold pressure gauge for each sea level engine equipped with a constant speed propeller, as well as for each altitude engine. The commentator stated that such a sea level engine is capable of being overboosted, if operated with the propeller adjusted for operations at high beta angles and the throttle adjusted for high power. The FAA does not agree since a "Sea level engine" as defined would be capable of producing rated takeoff power only at sea level. Therefore, the definitions of "Altitude engine" and "Sea level engine" are adopted as proposed.

Proposal 3–2. Based upon a further review, proposed new § 23.739 concerning a requirement for landing gear electrical ground connections is withdrawn.

Proposal 3–3. One commentator questioned the proposed amendment of § 23.901(b)(2) concerning easily removable engine cowls and nacelles to facilitate preflight checks. The commentator was of the opinion that the preflight check made by the pilot should be limited to oil level inspection and suggested that the proposal be revised to only require provisions so that the pilot can easily check the level of lubrication oil. The FAA does not agree with the commentator. Items other than the oil level need to be checked in the engine compartment during a preflight check and therefore the engine cowls and nacelles must be easily removable or openable by the pilot to facilitate these checks.

Another commentator objected to the phrase "sustained loss of power" in proposed § 23.901(b)(3), as being insufficiently definitive by prescribing a limit on the duration of power loss rather than the degree of power loss. The commentator suggested the use of the phrase "serious loss of power." The FAA does not agree. The phrase "sustained loss of power is consistent with present § 33.77(c), and was selected since the ingestion of rain can cause a power loss that is acceptable if it is not sustained. The commentator also objected to the prescribed rate of rain ingestion as being more severe than is presently prescribed or proposed for turbine engines in Part 25. The rain ingestion rate of 4 percent of engine airflow by weight is presently prescribed for all turbine engines of new design in § 33.77(f). Contrary to the commentator's contention, proposed § 25.1091(e) would apply the same rate in Part 25 to turbine engine installations using engines type certificated under regulations that did not include the current Part 33 requirement. The FAA believes that the rain ingestion rate is a reasonable certification requirement and is consistent with current § 33.77(f).

The commentator stated further that the moisture content should be that specified in Part 25, Appendix C, or two percent water content by weight. However, Appendix C defines an icing cloud and not a rain condition.

The commentator also stated that sufficient information regarding the collection and recording of the test data has not been provided and would be necessary to meet the requirements. The FAA did not intend to include administrative or type certification procedures in the proposal. No difficulty has been experienced in this regard during the type certification testing of turbine engines and no difficulty is foreseen in applying the proposed requirement.

The proposal is revised editorially for clarity.

Proposal 3–4. No adverse comments were received with respect to proposed deletion of § 23.939(b). The proposal, therefore, is adopted.

Proposal 3–5. No unfavorable comment was received for proposed new § 23.943, and the proposal is adopted without substantive change. See Proposal 3–26 for a discussion of related comments.

Proposal 3–6. No unfavorable comments were received on the proposal to amend § 23.959. Accordingly, the proposal is adopted without substantive change.

Proposal 3–7. In commenting on proposed § 23.967(a)(5) one commentator stated that problems of fatigue of tanks should be examined where a negative pressure could exist in the tank. The proposal covers only bladder cells and the FAA does not regard fatigue considerations to be pertinent to bladder cells. The proposal is editorially revised to ensure that the exception for zero or negative pressure is clear.

Proposal 3–8. For a discussion of comments related to proposed new § 23.973(d), see Proposal 3–31.

Proposal 3–9. Two commentators questioned proposed new § 23.975(a)(7). The commentators stated that the proposal to prevent fuel loss when the airplane is parked in any direction on a ramp having a one-degree slope did not adequately consider the problems of fuel discharged because of thermal expansion. The FAA agrees that the intent of the proposal was to consider normal parking situations but not thermal expansion. The proposal is revised to make that exception.

A commentator stated that proposed § 23.975(a)(8) could be interpreted as meaning that if at least two separate and independent vents are provided, neither has to meet the proposed requirements. The FAA believes the proposal is not clear and may cause a misinterpretation of current § 23.975(a). The proposal is therefore withdrawn.

Several commentators suggested revisions of § 23.975(a)(8). In light of the withdrawal of proposed paragraph (a)(8), these comments are not discussed.

Proposal 3–10. No unfavorable comments were received on the proposal to amend § 23.995. The proposal is revised editorially for clarity. Also see Proposal 3–13.

Proposal 3–11. For a discussion of comments related to proposed § 23.1093(b), see Proposal 3–34.

Proposal 3–12. A commentator objected to proposed § 23.1121(b) concerning the location and shielding of exhaust system parts because of a lack of specificity on how to determine whether the location of a system carrying flammable fluid is acceptable.

The FAA did not intend to state how an acceptable location would be determined since a number of acceptable methods might exist. The commentator also pointed out the possibility that a shield located close to a hot component might become hot enough to ignite flammable fluid. The FAA agrees and proposed §§ 23.1121(b), 25.1121(d), 27.1121 (d), and 29.1121(b) have been revised to make it clear that shields used for shielding exhaust system parts are also parts of the exhaust system. The commentator also questioned whether the flammable fluid leak sources to be considered are those around fittings or include those caused by rupture of a fluid carrying line. Proposed § 23.1121(b) covers any leakage from a flammable fluid system, including fluid-carrying lines and fittings, as well as the joints between them. Finally, the commentators stated that consideration should be given to fire detection and extinguishing equipment in showing compliance with proposed § 23.1121(b). The FAA does not agree since it is necessary to take steps to both prevent and control fires.

A commentator stated that proposed § 23.1121(b) would make an adequate design difficult to achieve and contended that the resultant design would be complex with an inherent lower reliability than a simple system. The FAA does not agree. The proposal specifically allows the use of exhaust system shielding as a method of avoiding impingement of flammable fluids. Therefore, the FAA believes the proposal would reduce design difficulties. The commentator also stated that it would be virtually impossible to prove whether the objective of the proposal had been met. The FAA does not foresee any difficulty in administering the requirement.

No unfavorable comments were received on the proposed new § 23.1121(h). Accordingly, the proposal is adopted without substantive change.

Proposal 3–13. A commentator noted that proposed § 23.1141(g)(1) would prohibit the use of a rotary type switch for selecting fuel supply from more than one tank, and suggested that the proposal be revised to read: "For manual valves, positive stops or in the case of fuel valves suitable index provisions, in the open and closed position." The FAA agrees and proposed §§ 23.1141(g)(1), 25.1141(f)(1), 27.1141(c)(1), and 29.1141 (f)(1) are revised accordingly.

Several commentators concurred with proposed §§ 23.1141(g)(2) and 25.1141(f)(2) but believed that the pilot might not have a clear picture of the effect of valve position and recommended that the proposal be revised to require means to indicate proper valve operation to the flight crew. Another commentator stated that it is unnecessary to require indication of actual valve position with power-assisted valves and that it would be sufficient to indicate open and closed positions. Proposed §§ 23.1141(g)(2) and 25.1141(f)(2) were not intended to require an indication of the proper functioning of a power-assisted valve or to require an indication of each of the numerous possible valve positions. In addition, the proposal, as stated in the explanation, would recognize the acceptability of intransit light indicators. Therefore, proposed §§ 23.1141(g)(2), 25.1141 (f)(2), 27.1141(c)(2), and 29.1141(f)(2) have been revised accordingly.

Proposal 3–14. No unfavorable comment was received on the proposal to amend § 23.1145(c). However, see the discussion of Proposal 3–40 for a revision of proposed § 23.1145(c).

Proposal 3–15. One commentator suggested that proposed § 23.1193(f) be revised to require a "fireproof" standard and to combine it with the fireproof standard for cowlings in current § 23.1193(e). The FAA does not agree since adopting the suggestion would result in an unduly severe provision. The proposal offers the design alternatives for multiengine airplanes with supercharged engines of fireproof nacelle skin or fireproof cowling skin. Furthermore, the proposal is consistent with a similar provision in Part 25.

A second commentator believed that there should be a tradeoff between fire detection and extinguishment requirements. The FAA believes that both this proposal relating to fire containment and Proposal 3–16 relating to fire detection are necessary in light of service experience. The commentator also felt that the proposal should refer only to engines with mechanically driven superchargers and not to all supercharged engines. The FAA disagrees since there have been fires on supercharged engine installations other than those with mechanically driven superchargers and the proposal is applicable to all supercharged multiengine powered airplanes.

Another commentator questioned whether the reference in the proposal to supercharged engines was intended to include engines with turbo-superchargers. The term "supercharged" covers both mechanical and turbo-supercharged engines.

Proposal 3–16. One commentator requested that proposed new § 23.1203 concerning fire detector systems be revised to exclude turbocharged multiengine powered airplanes because these airplanes are not any more susceptible to fire than airplanes with sea level engines. The FAA disagrees. Service experience indicates that multiengine powered airplanes incorporating turbo-superchargers are more susceptible to fires than those that do not incorporate turbo-superchargers.

Another commentator opposed the proposal on the grounds that fire detection systems have not been shown to be necessary for general aviation aircraft and that the emphasis should be placed on fire prevention. The commentator also stated that there has been a history of false fire detection signals that have resulted in unscheduled landings and needless engine shut-downs. The FAA agrees that fire prevention is important and proposals have been made in the Airworthiness Review Program to enhance aircraft fire prevention capabilities. However, there is a need to require fire detection provisions so that early action can be taken if a fire occurs. Also, false fire warnings, associated with early detection systems on transport category airplanes, do not occur to an unacceptable degree in present detector systems which have the benefit of many years of service experience and technical improvements. The proposal is adopted with only minor editorial changes.

Proposal 3–17. For a discussion of the withdrawal of proposed § 23.1305(h), see Proposal 3–59.

For a discussion of comments on proposed § 23.1305(w) concerning fire warning indicators for those airplanes required to comply with § 23.1203, see Proposal 3–16.

Proposal 3–18. One commentator agreed with the intent of the proposal for § 23.1337 (a) concerning powerplant instruments and instrument lines that utilize flammable fluids, but suggested a number of changes to make the provision more specific. The FAA does not agree. Flexibility in the requirement is necessary to avoid creating unnecessary design restrictions. The commentator suggested that a fire extinguisher be specified for compliance with the proposed rule. The FAA does not agree. The intent of the proposal is to prevent the occurrence of a fire hazard.

Another commentator did not concur with the proposal on the grounds that §§ 23.853 (d) and 23.993 adequately cover its intent and it would result in undue crowding in the cockpit area. The FAA disagrees. The proposal contains necessary provisions not covered by § 23.993 and deals with locations not covered by § 23.853(d). In addition, the FAA has no data to indicate that crowding in the cockpit area would result from the proposal.

Proposals 3–19 and 2–44. Proposed § 23.1557(e) was intended to implement the requirement in Proposal 3–2 and is withdrawn because of the withdrawal of that proposal.

Disposition of Proposal 2–44 to amend § 23.1557 (Notice 75–10) was deferred so that it could be considered in connection with Proposal 3–19. No unfavorable comment was received on Proposal 2–44. Accordingly, the proposal is adopted without substantive change.

Proposal 3–20. Based upon a further review, proposed new § 25.739 concerning a requirement for landing gear electrical ground connections is withdrawn.

Proposal 3–21. One commentator suggested that the installation instructions of proposed § 25.901(b)(1)(i) should be limited to those installation design parameters pertinent to the engine type certificate. The installation instructions provided under § 33.5 include only those parameters referred to by the commentator, and the FAA believes that a revision of the proposal is not needed. Also see Proposal 3–51.

Two commentators objected to the use of the term "extremely remote" in proposed § 25.901(c) as not being clearly understood. The FAA believes the term is appropriate since it has been used in other sections of the regulations, without administrative difficulty, to establish the consideration that must be given to the failure of structural components during the evaluation of the type design.

One commentator believes that the proposal would make § 25.1309 inapplicable to powerplant or APU installations. The FAA disagrees; § 25.1309 would continue to apply to powerplant and APU installations.

Another commentator concurred with the proposal if, with respect to APUs, it is limited to those approved for use in flight. The FAA does not believe the proposal should be so limited since the failure or malfunction of an APU approved for use only on the ground could jeopardize safe operation on the ground and in flight. The proposal is adopted without substantive change.

Proposal 3–22. One commentator recommended revising proposed § 25.903(e)(2) to require only the establishment of an envelope that defines the inflight restart capability. The FAA disagrees since this recommendation would not explicitly require restart capability, which was the intent of the proposal and which the FAA believes is essential for safe operation.

Another commentator questioned the deletion of the fire resistant requirement for engine restarting from current § 25.903(c). The FAA believes, due to the very limited use of an engine after a fire in the engine, that the benefit of requiring the components of the restarting system to be fire resistant are slight. The FAA thus can no longer justify this requirement.

A commentator did not concur with proposed § 25.903(e)(3) because it provides for ignition but not for rotational capability sufficient for an engine start. The proposal however was not intended to require a power source for rotation where windmilling speeds are too low for restarting. The proposal would provide the necessary electrical power for engine ignition whether or not the windmilling speed was adequate for an engine start. The proposal is adopted without substantive change.

Proposal 3–23. Several commentators believed the reference in proposed § 25.933(a) to engine idle forward thrust was misleading and that the word "forward" should be deleted. One commentator suggested the word "reverse" be used instead of "forward". However, the direction of the thrust produced by the engine is not pertinent to the proposal. The resultant thrust is controlled by the reverser position. Therefore, the word "forward" is deleted.

One of the commentators believed that the allowable engine thrust setting should be stated as a percent of maximum or in terms of aircraft performance. The commentator suggested "flight idle" be used in place of "idle". The proposal was intended to require the engine thrust to be reduced to the thrust produced at idle in flight and the proposal has been revised to specify flight idle. The same commentator believed the proposal could be interpreted to include the malfunction of all reversers and an unlimited combination of failure modes. The proposed lead-in paragraph (a) is revised to make it clear that consideration must be given to each reverser but only one reversal at a time.

Another commentator recommended that the proposal be revised to require the prevention of inadvertent thrust reversal in flight. The FAA disagrees. Section 25.1155 currently requires consideration of inadvertent operation for each reverse thrust control.

A commentator stated that present § 25.933(d) covers the proposal. The FAA does not agree. Proposed § 25.933(a) would apply to all cases of in-flight thrust reversal of a reverser intended for ground operation only. Section 25.933(d) on the other hand applies only to malfunctions of the thrust reverser system that affect directional control.

Another commentator suggested that the word "condition" at the end of the proposed paragraph (a)(2) should be changed to "position". The FAA agrees that the significant status of the reverser is its position and the proposal is revised accordingly.

Finally, a commentator stated in view of the requirements in § 25.1155, proposed § 25.933(a) should be limited to systems failures. The FAA disagrees. The consequence of an in-flight thrust reversal is the same whether the reversal results from malfunction or the control is moved to the reverse position. Both situations have occurred in service and need consideration. The commentator also suggested replacing "possible" by "probable" in proposed § 25.933(a)(2) because "possible" does not define the limit of failure analysis or test configuration that has to be considered. However, the FAA believes that any degree of deployment of the reverser should be considered.

Proposal 3–24. No unfavorable comment was received on the proposal to delete § 25.939(b) and the proposal is adopted.

Proposal 3–25. One commentator suggested that the heading of proposed new § 25.941 be revised to read "Thrust or power augmentation system" for clarification. The FAA agrees and the heading is revised as suggested. The same commentator also

pointed out that the section designation § 25.941 had been used in connection with another proposal in Notice 75–10. The FAA agrees and the section as adopted is designated as § 25.945.

A commentator suggested that proposed § 25.941(b)(2) should be clarified by adding the word "maximum" before the language "operating pressure". The FAA agrees, and the proposal as adopted has been so clarified.

A commentator referring to proposed § 25.941(b)(3), stated that it is not necessary to specify how the venting should be done and suggested that the proposal be revised to require that the venting arrangements for each tank must perform their intended functions under any foreseeable conditions. While the FAA does not agree with the revision suggested by the commentator, the FAA does agree that the vent need not be from the "top" of the expansion space. If the venting is effective under "any normal flight condition" the vent could be located in other places in the expansion space. Proposed § 25.941(b)(3) is revised accordingly to allow the applicant any needed flexibility.

Another commentator on proposed paragraph (b)(3) stated that the proposal would preclude pressurization as a means of pumping. The FAA agrees. The proposal was not intended to preclude pressurization and is revised to apply only to vented tanks.

A commentator suggested a revision of proposed § 25.941(b)(4) that would require marking each tank filler cap to specify "usable tank capacity" rather than tank capacity. However, after further review the FAA does not believe a requirement for marking the cap with "tank capacity" or "usable tank capacity" is necessary and the requirement is deleted from the proposal.

Another commentator thought that placards should be treated separately from system design and that the proposal should be deleted because similar requirements for fuel and oil systems are being considered for deletion. The FAA believes that marking the tank fluid opening to identify the fluid to be used may avoid the inadvertent use of incorrect fluids.

One commentator stated that it is highly probable that the filler cap will not be large enough to indicate the required markings and that markings adjacent to the fluid filler cap should be allowed as is the case for § 25.1557(b). The FAA agrees and paragraph (b)(4) is revised to require marking at or near the filler cover.

On the basis of comments received and upon further review, the FAA believes that adoption of proposed § 25.941(b)(5) is not appropriate at this time and the proposal is withdrawn.

Another commentator believed that the proposal should be combined with § 25.963(e) to cover all fluid tanks. The FAA agrees that current § 25.963(e) should be combined with other augmentation system requirements but does not believe that augmentation system requirements and fuel tank requirements should be combined. Proposad § 25.941 and current § 25.963(e) are combined in a new § 25.945.

Finally, a commentator on the fuel-injection exclusion in proposed paragraph (d) questioned whether water-methanol as used on the Rolls-Royce Model 542 (Dart) would be regarded as a fuel. In the Dart application, the water-methanol system is not regarded as a fuel injection system. Therefore, the water-methanol system used on the Dart engine would not be excluded from the augmentation system requirements of § 25.945.

Proposal 3–26. Several commentators objected to proposed new § 25.943 concerning the effect of negative accelerations on engine and APU operation. One commentator recommended that the word "sustained" be used in place of the word "hazardous" in relation to which malfunctions need be considered under the proposed rules. The FAA disagrees since the significance of a malfunction is whether it is hazardous, irrespective of its duration.

A commentator did not concur with the proposal, stating that a differentiation is necessary between ground-use APUs and other APUs. The commentator apparently misinterpreted the proposal since the proposal explicitly applies to an APU only if it is approved for use in flight.

Two commentators indicated that the proposal should be limited to APUs that are essential to the safety of flight. The FAA does not agree since the malfunction of a

nonessential APU approved for use in flight might be hazardous. All flight-use APUs should therefore be evaluated under the proposal.

A commentator stated that since negative acceleration could affect all engines simultaneously, the requirement should refer to "engines". The proposal applies to any engine at any point during the negative acceleration and would necessarily include a determination of the effect of negative acceleration on each engine during the entire acceleration.

One commentator requested information on the duration of acceleration to be considered. The duration of acceleration to be considered under the provision is that expected in service and depends on the maneuver-time history of the particular aircraft type being evaluated within its flight envelope. The proposal is adopted without substantive change.

Proposal 3–27. A commentator objected to the list of factors in proposed § 25.952(a) concerning characteristics that a test article must have that is used to reproduce the general fuel system. The commentator stated that in many cases the list is not complete and therefore may be misleading. Upon further review the FAA agrees that the specific list of characteristics may not be appropriate in all cases. The FAA believes that revision of the proposal to require that the test article must reproduce the operating characteristics of the portion of the fuel system to be tested will allow appropriate flexibility in determining the tests that are necessary and will eliminate the need for the list of factors which are already included within the term "operating characteristics".

Several commentators believed that the proposed § 25.952(b) was too restrictive. One commentator suggested that paragraph (b) be revised to read "The likely failure of any heat exchanger using fuel as one of its fluids may not result in a hazardous condition". The FAA agrees that contamination of either fluid does not always result in a hazardous condition and the requirement need not be as restrictive as proposed. Proposed § 25.952(b) is revised accordingly.

One commentator also commented that proposed paragraph (b) should apply only to heat exchangers that are part of the airplane fuel system and that engine heat exchangers should be controlled by a similar requirement in Part 33. The FAA disagrees. The evaluation whether contamination or other likely failure could cause a hazardous condition can only be determined in a particular airplane installation. Therefore, the proposal is applicable to airplane-furnished and engine-furnished heat exchangers.

Proposal 3–28. One commentator questioned the proposed clarification of § 25.959. While the commentator agreed that unusable fuel supply should be determined under § 25.959 without considering fuel system component failures, the commentator believed that if a failure of a fuel system component would produce a greater amount of unusable fuel that fact must be determined in certification and made known to the operator. Fuel system component failures are not a required consideration under § 25.959. However, if the FAA determines that additional information is necessary for safe operation, this information must be furnished to the operator under the requirements of subpart G of Part 25. Accordingly, the proposal is adopted without substantive change.

Proposal 3–29. One commentator stated that proposed § 25.963(f) did not contain a provision to ensure fuel flow if the regulator failed and that there should be a manual back up for the crew in the event of a system failure. The proposal was not intended to ensure continued fuel flow after a regulator failure. The required fail-safe features are only intended to ensure the prevention of over-pressurization. The FAA, furthermore, does not believe that an additional requirement for a specific manual system has been justified. The proposal is revised to ensure this intent.

Two other commentators believed that an automatic regulating means or a mechanical pressure regulating device need not be required if there are fail-safe features to prevent excessive pressure buildup. The FAA agrees and the proposal is revised to require a means with fail-safe features to prevent the buildup of excessive pressure differential between the inside and outside of the tank.

Proposed § 25.1305(a)(9) concerning powerplant instruments would have required a means to check the operation of the automatic regulating means in proposed § 25.963 (f). Since paragraph (f) as revised would not require a means to regulate fuel tank pressure, an instrument to check this operation should not be required. Therefore, proposed § 25.1305(a)(9) is withdrawn.

See Proposal 3–25 for discussion of the transfer of current § 25.963(e), concerning augmentation liquid tank capacity, to § 25.945(e).

Proposal 3–30. One commentator interpreted § 25.965(d) to mean that only a pressure test is required for non-metallic fuel tanks. The commentator recommended that slosh testing be added to proposed new § 25.965(d) as a requirement for non-metallic tanks in transport category airplanes. The FAA does not agree with the recommendation since § 25.965(c) already requires slosh testing of all non-metallic tanks except where satisfactory experience with a similar tank in a similar installation can be shown.

Two commentators concurred with the proposal but believed the words "analysis or" should be inserted in conjunction with the word "tests" because analysis may be adequate in showing compliance, either alone or when combined with a limited test program. Furthermore, when the tank is an integral tank the structural loading, including aerodynamic loads, is not always amenable to test. The FAA agrees, and the proposal is revised by inserting the words "analysis or" before the word "tests".

Proposal 3–31. Sections 23.973(d) and 25.973(d), as proposed, are identical and concern the electrical bonding of the airplane and fueling equipment.

The FAA agrees with two commentators who stated that where a metal-to-metal bond is made between the airplane and the fueling equipment no need exists for separate electrical bonding of the fuel nozzle to the airplane fueling connection. The FAA believes that considering airplane and ground fueling systems being used today metal-to-metal contact will exist during pressure refueling. Therefore, the proposals are revised to except pressure fueling connection points from the fuel system electrical bonding provision.

Another commentator opposed the proposal on the grounds that there are no statistics to show that the present procedure is unsafe and that requiring special ground connections would increase cost and impose an unnecessary economic burden. The FAA does not concur because the flow rates associated with fueling without proper bonding can induce an electrostatic discharge sufficient to ignite fuel vapor.

A third commentator believed that a review of all fueling procedures should be conducted, in which the subject of grounding points would be one of several subjects to be considered, and that the review should be undertaken before any new rule affecting those procedures is adopted. The FAA agrees that an overall review of fueling procedure and equipment might be desirable; however, the FAA is not aware of any substantive reason to delay the adoption of the proposal with the change discussed above.

Proposal 3–32. No unfavorable comments were received on the proposal to amend § 25.995. Accordingly, the proposal is adopted without substantive change. Also see Proposal 3–39.

Proposal 3–33. One commentator questioned the proposed amendment to § 25.1091. The commentator stated that incorporating APU requirements into the propulsion engine requirements is confusing and unnecessary and that each APU would have to meet the propulsion engine foreign object ingestion test requirements for takeoff, flight idle, and cruise conditions although APUs do not undergo these conditions. The FAA agrees that paragraph (e) should not apply to APUs since foreign object ingestion by APUs is not considered to be a significant problem. However, the FAA believes that applicability of the other requirements to APUs is necessary for the reasons stated in the explanation for the proposal. The commentator also believed that to comply with proposed paragraph (e), the installed engine must repeat the ingestion test requirements of § 33.77. The FAA did not intend to require that the ingestion test requirements be repeated on engines that had already shown compliance with § 33.77. The FAA believes that the test required by § 33.77 during engine type certification adequately accounts for the effects of inlet ingestion on the powerplant installation. Proposed § 25.1091(e) is revised accordingly to apply only to turbine engines and to include only those engines that had not been shown during engine type certification to comply with § 33.77.

Another commentator recommended that proposed paragraph (e) be revised to require each turbine powerplant installation to "be consistent with the foreign object ingestion requirements of § 33.77." The FAA believes that the revised proposal attains the objective of the recommendation. The proposal is adopted with the revisions noted.

Proposal 3–34. Several comments were made on proposed §§ 23.1093 and 25.1093 that did not take into consideration Amendment Nos. 23–15 and 25–36, effective October 31, 1974. Proposals 3–11 and 3–34 proposed only a minor change to make it clear that the requirements of §§ 23.1093(b) and 25.1093(b), concerning ice accumulation caused by the ice and snow expected within the approved flight envelope, cover air inlet system components.

Proposed §§ 23.1093(b), 25.1093(b), 27.1093(b), and 29.1093(b) are modified by inserting the word "operate" in place of the words "function properly" for consistency in terminology with the current §§ 23.1093(b), 25.1093(b), 27.1093(b), and 29.1093(b).

Proposal 3–35. The proposal for § 25.1103(d), concerning turbine engine air duct systems, is related to a proposed amendment to § 25.1103 that is contained in Airworthiness Review Program Notice No. 8 (Notice 75–31). The proposed amendment to § 25.1103(d), contained in Notice No. 3, is therefore deferred until final rule-making action with respect to the related proposal in Notice 75–31. Comments submitted for Proposal 3–35 will be considered at that time.

Proposal 3–36. One commentator suggested that proposed § 25.1121(b) be revised by adding the words "probable" before "leakage" and "hazardous" before "fire". The FAA does not agree. The consequences of leakage from systems carrying flammable fluids can be sufficiently hazardous to warrant the assumption of leakage even if not probable. Also, the FAA regards any fire as being hazardous.

For the reasons given in the discussion relating to Proposal 3–12, proposed § 25.1121 (b) has been revised to make it clear that shields used for exhaust system parts are parts of the exhaust system.

Proposal 3–37. One commentator agreed with the proposed amendment to § 25.1123 but preferred to see all APU requirements separately stated rather than combined with the requirements for propulsion engines. The FAA, however, believes that identical requirements should be in the same section unless the applicability needs further clarification. Since no need was shown by the commentator, the proposal is adopted without substantive change.

Proposal 3–38. In response to an inquiry in the explanation of proposed new § 25.1129, several commentators stated that the proposal was covered by proposed § 25.901(c). The FAA agrees and the proposal is withdrawn.

Proposal 3–39. Several commentators stated that proposed § 25.1141(f) should apply only to valves that are essential to the safe operation of the airplane. The FAA disagrees. If any power-assisted valve is used, the flight crew might rely on it and should have an indication of when the valve is in the fully open or fully closed position, or when it is moving between the fully open and fully closed position.

The same commentators noted that an indication that the valve has attained the selected position should be required. For discussion of this comment and revision of new §§ 25.1141(f)(1) and (2), see Proposal 3–13.

Proposal 3–40. Several commentators objected to proposed §§ 25.1145(c), 27.1145(b), and 29.1145(c), concerning groups of ignition switches. The commentators stated that these new requirements were not necessary for turbine engines that do not require continuous ignition. The FAA agrees, since inadvertent movement of the ignition switch would not affect the operation of such an engine once that engine has been started. Accordingly, §§ 23.1145(c), 25.1145(c), 27.1145(b), and 29.1145(c) are revised to except the ignition switches for these engines from the requirement to have a means to prevent inadvertent operation of the group of ignition switches.

Proposal 3–41. The proposed § 25.1195(b), concerning fire extinguisher discharge, is related to a proposed amendment to § 25.1195(b) that is contained in Airworthiness Review Program Notice No. 8 (Notice 75–31). The proposed amendment to § 25.1195(b) contained in Notice No. 3, is therefore deferred until final rule-making action with respect to the related proposal in Notice 75–31. Comments submitted for Proposal 3–41 will be considered at that time.

Proposal 3–42. No unfavorable comments were received on the proposal to amend § 25.1197. Accordingly, the proposal is adopted without substantive change.

Proposal 3–43. A commentator recommended a revision of the first sentence of proposed § 25.1199(b) concerning the location of pressure relief discharges of fire ex-

tinguishing agents. The commentator suggested that the discharge end be required to be located to avoid hazard to the airplane rather than damage. The FAA disagrees. The proposal is intended to provide for the consideration of damage such as corrosion that may be caused by the discharge of fire extinguishing agents. The commentator's suggestion would not clearly provide for such necessary consideration.

Proposal 3–44. One commentator questioned proposed § 25.1207. The commentator stated that analysis should not be permitted as the sole method of showing compliance with the fire protection requirements. The FAA agrees that some of the requirements of §§ 25.1181 through 25.1203 may be complied with by analysis alone, while others require other methods of substantiation. Section 25.1207(d) is therefore revised to make clear that unless tests are specifically required in §§ 25.1181 through 25.1203 analysis is an acceptable method of showing compliance.

Another commentator pointed out that proposed § 25.1207(b) as written would preclude the use of the Statham test to determine extinguisher agent concentrations in an actual fire zone, contrary to his understanding that the Statham test method is acceptable. The FAA agrees and proposed paragraph (b) is revised to specify "tests of components," instead of "bench fire tests of components."

Proposal 3–45. For a discussion of the withdrawal of proposed § 25.1305(a)(9), see Proposal 3–29.

Proposals 3–46 and 2–86. Disposition of Proposal 2–86 (Notice 75–10) to amend § 25.1337(a) was deferred so that it could be considered in connection with Proposal 3–46, also to amend § 25.1337(a).

Two commentators concurred with Proposal 2–86, but believed that a review of other paragraphs of Part 25 affecting APU installations is required. The FAA does not agree. If other requirements are determined to be applicable to APU installations, additional proposals will be made in future rule-making actions. The FAA finds no reason to withhold adoption of these proposals pending such a determination.

No unfavorable comment was received on Proposal 3–46 and the proposal is adopted without substantive change.

Proposals 3–47 and 2–94. Disposition of Proposal 2–94 (Notice 75–10) to revise §§ 25.1549(a), (b), and (c) was deferred so that it could be considered in connection with Proposal 3–47, to amend § 25.1549(d).

One commentator concurred with Proposal 2–94, but pointed out that while it accommodated vertical scale instruments it did not accommodate horizontal scale instruments. The FAA agrees, and § 25.1549 as adopted will provide marking standards appropriate to circular, horizontal, and vertical scale powerplant instruments.

Another commentator believed that the proposal to provide specific requirements for marking vertical tape instruments, to provide for cockpit instrument standardization, is not appropriate for today's turbine engines. The commentator indicated the requirement could produce overlapping markings which could be misleading and, under certain operating conditions, could indicate that an unsafe condition is safe. The commentator recommended that markings for vertical tape engine instruments not be specified because such standardization is not in the best interest of safety. The FAA believes that overlap markings on tape instruments, similar to the overlap markings on round face instruments, will provide an adequate and safe presentation.

No unfavorable comment was received on Proposal 3–47, to amend § 25.1549(d) and the proposal is adopted without substantive change.

Proposal 3–48. Proposed § 25.1557(e) was intended to implement the requirement in Proposal 3–20 and is withdrawn because of the withdrawal of that proposal.

Proposal 3–49. No unfavorable comment was received on the proposal to amend § 25.1585. Accordingly, the proposal is adopted without substantive change.

Proposal 3–50. One commentator objected to the proposed amendments to §§ 27.571 (a) and 29.571(a). The commentator stated that the addition of the language "rotor drive systems between the engines and the rotor hubs" to the parenthetical description of flight structure is misleading and unnecessary. In support, the commentator suggested that the fatigue evaluation of the rotor drive system is accomplished upon compliance with §§ 27.923 or 29.923. The commentator's reply indicates (as was noted in the explanation for the proposals) the need for a clarification that the fatigue evalua-

tion of §§ 27.571 and 29.571 includes portions of the rotor drive system. Sections 27.923 and 29.923 are primarily endurance test requirements, while §§ 27.571 and 29.571 are the fatigue evaluation requirements. It is therefore appropriate to include the rotor drive systems in the parenthetical description of the flight structure that must be included in the fatigue evaluation of §§ 27.571 or 29.571, as applicable.

Accordingly, the proposed amendments to §§ 27.571(a) and 29.571(a) are adopted without substantive change.

Proposal 3–51. One commentator objected to the proposed amendments to §§ 27.901 (c)(1) and 29.901(b)(1)(i) that, if adopted, would require compliance with the engine installation instructions provided under § 33.5(a). The commentator stated that the installation instructions are apparently aimed at field information for the owner and in any case § 33.5 does not require that this information be provided until just prior to engine certification in many cases. The commentator recommended that the requirement should not refer to § 33.5 but to specific engine installation parameters which are essential to proper engine performance and which are exclusively the responsibility of the engine manufacturer.

The installation instructions of § 33.5(a), in general, include a description of the location of mounting attachments and methods of attachment of the engine and engine components. The FAA believes this information is particularly pertinent to rotorcraft type certification. The FAA further believes that the installation instructions will be prepared by the engine type certificate applicant at the early stages of the engine type certification program. The commentator's suggestion that specific engine installation parameters be identified (rather than adopting the proposed reference to § 33.5) could lead to the failure to consider other installation parameters that may be significant to safety. Also see Proposal 3–21.

Proposal 3–52. Two commentators suggested that proposed § 27.923(e) may be subject to misinterpretation but indicated that this was not a problem to them. Proposed § 27.923(e) includes language similar to current § 29.923(b)(2). The FAA believes these requirements should be consistent and therefore believes the wording should be similar to avoid a different interpretation.

Two commentators objected to proposed § 27.923(j) concerning the 30-minute power test for certain multiengine rotorcraft. The commentators indicated that proposed § 27.923(j) is inconsistent with proposed § 27.923(b) since more than 100 hours of testing would be required. The FAA does not believe that the proposed paragraphs are inconsistent. Proposed paragraph (b) would require that the rotor drive system and controls on all rotorcraft be tested for not less than 100 hours, and proposed paragraphs (c) through (e) would merely establish the kinds of tests included in those 100 hours. Proposed paragraph (j), which would apply only to rotorcraft for which the use of 30-minute power is requested, would require testing in addition to the 100 hours.

Another commentator stated that the FAA should not "bother with the change from 'power' to 'torque' as it leads to very confusing wording". The change of language to "torque" and "speed" was proposed because the FAA believes these are the parameters generally used by applicants in conducting the rotor drive system tests. The additional reference in the proposal to power, e.g., the 2½ minute and 30-minute power runs specified in paragraphs (e) and (j), is made to establish the relationship between the torque and speed and the corresponding engine power rating.

A commentator considered the cyclic aspect of testing to be important and suggested that the proposal specify the number and duration of cycles rather than the overall time. The FAA disagrees. The proposal does not change the terms of current § 27.923(f) which provides flexibility in establishing testing intervals (cycles). The FAA is not aware of a problem that would justify changing these minimum test intervals.

The same commentator also believed the proposed test runs at 2½ minute and 30-minute power were inadequate and compared poorly with the test required to qualify the engine under Part 33. The FAA disagrees. As stated in the explanation, the 2½ minute and 30-minute power test in the proposal for a normal category rotorcraft is to demonstrate that the rotor drive system can absorb the torque of engines operating at 2½ minute and 30-minute power. These ratings, however, are not incorporated into the performance requirements as is the case under Part 29, for transport category rotorcraft,

and no performance credit is realized from their use. Therefore, the FAA believes the test is adequate under Part 27.

Proposals 3–53 and 2–118. Proposal 2–118 was deferred so that it could be considered with Proposal 3–53 since both proposed to amend § 27.927(b)(2). Proposal 2–118 would change the words "one hour" in § 27.927(b)(2) to "fifteen minutes". In this connection a commentator asked if due consideration had been given to the 30-minute emergency power rating when establishing the time requirement. The 30-minute power is taken into account by the terms of the requirement for test at maximum torque attainable under probable operating conditions.

Two commentators to Proposal 3–53 believed that in proposed § 27.927(b)(2) the word "outputs" should be "inputs". The FAA agrees and the proposal is revised accordingly.

One commentator stated that the 15-minute duration specified in proposed § 27.927(c), concerning operation after loss of oil pressure, should be 5 minutes to bring it into line with the protection time specified in current § 27.861. The FAA does not agree. The 5-minute duration is specified in § 27.861 since the occurrence of a fire normally necessitates immediate descent and landing. Loss of oil pressure in the rotor drive system does not correspondingly necessitate immediate descent and landing. The 15-minute requirement would provide for a reasonable durability of the system following the loss of oil pressure.

Two commentators believed that in proposed § 27.927(c) the term "autorotative conditions" was vague and should be replaced with the term "the low power conditions of autorotative flight". The FAA does not agree. Under autorotative conditions no power is transmitted from the engine to the rotor blades. Therefore a low power condition of the engine would not be applicable.

A commentator believed that the use of the word "torgue" in place of "power" was confusing. The commentator indicated that the proposal could be interpreted to permit a static test since only torque and no rotational speed is specified. The proposal to use the word "torque" was made since the tests are run on the basis of the torque absorbed by the rotors. The torque being absorbed is that produced by the operating engine and transmitted through the rotor drive system.

A commentator stated that proposed paragraph (c) did not consider the design alternative of a back-up oil system. The FAA agrees that compliance by the use of a second oil system after failure of the primary system should be allowed. Proposed §§ 27.927(c) and 29.927(c) are revised accordingly.

A commentator suggested that it should be noted that the drive system need not be in condition for continued operation after the 15-minute test prescribed in paragraph (c). The FAA agrees that compliance with the proposal would be achieved after the 15-minute test was successfully run regardless of the condition of the rotor drive system.

Proposal 3–54. No unfavorable comments were received on the proposal to amend § 27.965. Accordingly, the proposal is adopted without substantive change.

Proposal 3–55. Several commentators to the proposed amendment of §§ 27.1093(b) and 29.1093(b) apparently failed to note the changes made by Amendment Nos. 27–9 and 29–10 (39 FR 35452; October 1, 1974). The proposals intended only to add the language "and its air inlet system" to §§ 27.1093(b)(1) and 29.1093(b)(1) and to restructure both sections to incorporate the added language. For a discussion of a change made to proposed § 27.1093(b), see Proposal 3–34.

Proposal 3–56. One commentator stated that § 27.1121(d), unlike §§ 23.1121(b) and 29.1121(b), did not need the clarification proposed. The FAA agrees that § 27.1121(d) did not use the language "dangerously close" that had been an administrative problem in §§ 23.1121(b) and 29.1121(b). However, beside the desire for consistency among the airworthiness certification parts, the FAA believes that proposed § 27.1121(d) provides a more comprehensive standard and will allow greater design flexibility.

For a discussion of changes made to proposed § 27.1121(d), see Proposal 3–12. No unfavorable comments were received concerning proposed § 27.1121(g) and it is adopted without substantive change.

Proposal 3–57. A commentator objected to proposed § 27.1141(d). The commentator stated that this proposal was not deemed necessary for Part 29 and asked why it

was necessary for Part 27. The FAA disagrees that a similar requirement was not deemed necessary for Part 29. Proposed § 29.901(c) that is adopted in this amendment will require a similar consideration for powerplant controls in transport category rotorcraft. Further, the FAA believes that this requirement is necessary for normal category rotorcraft. Many turbine powerplant control systems on normal category rotorcraft are inherently complex. Considering such complexity, the FAA believes that consideration must be given to system redundancy, alternate devices, and duplication of functions in the design of certain turbine powerplant control systems.

Another commentator stated that the proposal to add a new § 27.1141(c) would require position indicators for all powerplant controls and considered this to be an excessive and unnecessary requirement. The FAA disagrees. The proposed new § 27.1141 (c) applies only to powerplant valve controls located in the cockpit. For discussion of the revision of new §§ 27.1141(c)(1) and (2), see Proposal 3–13.

Proposal 3–58. One commentator stated that the proposed changes to §§ 27.1145(b) and 29.1145(c), concerning the prevention of inadvertent operation of each group of ignition switches, would seem to contradict current §§ 27.1145(a) and 29.1145(b). Sections 27.1145(a) and 29.1145(b) require a means to quickly shut off all ignition by the grouping of switches or by a master ignition control. The FAA believes that the means provided to prevent inadvertent operation can be designed so that it will not prevent or adversely affect the ability to quickly shut off all ignition.

See Proposal 3–40 for a discussion of the revision of proposed § 27.1145(b) to provide an exception for turbine engines that do not require continuous ignition.

Proposal 3–59. A commentator stated that the revisions proposed for §§ 27.1305(e) and 29.1305(a)(5), concerning altitude engines, are not needed since the current rules are clear. The FAA believes that, considering the proposed new definition for an "altitude engine" that is adopted as an amendment to § 1.1 in this document, the proposed revisions concerning altitude engines in the airworthiness rules are not needed. The term "altitude engine" that is used in §§ 23.1305(h), 27.1305(e), and 29.1305(a)(5) will include a derated engine as well as a supercharged engine after the amendment to § 1.1. Accordingly, proposed §§ 23.1305(h), 27.1305(e), 29.1305(a)(5) are withdrawn.

Proposal 3–60. No unfavorable comments were received on the proposal to amend § 27.1337(a). Accordingly, the proposal is adopted without substantive change. Also see Proposal 3–18.

Proposal 3–61. For a discussion of a comment concerning § 29.571(a), see Proposal 3–50.

Proposal 3–62. A commentator stated that proposed §§ 29.901(b)(1)(iii) and (c) are redundant and unnecessary. The FAA agrees that proposed § 29.901(b)(1)(iii) is unnecessary, and it is withdrawn. The FAA does not agree that proposed § 29.901(c) is redundant and unnecessary. Experience has shown the need for a failure requirement that is explicitly applicable to powerplant and auxiliary power unit installations.

One commentator stated that considering probable combinations of failures in proposed § 29.901(c) is inconsistent with the overall philosophy of Part 29. However, since the commentator did not state its view of the overall philosophy of Part 29, the FAA cannot respond to this comment.

The commentator suggested that engine rotor disc failures should be excluded from the consideration required by paragraph (c) since the rotorcraft environment is much more complex than in the case of an airplane. Also the commentator asserted that a lower incidence of fatigue failure can be expected in rotorcraft engines than in airplane engines. The FAA agrees and § 29.901(c) is revised to exclude engine rotor disc failures from consideration under that paragraph.

For comments related to the proposed amendment of § 29.901(b)(1)(i), see Proposal 3–51.

Proposal 3–63. No unfavorable comment was received on the proposed deletion of paragraphs (d) and (e) in § 29.903, and the paragraphs are deleted. Also, see Proposal 3–64.

Proposal 3–64. A commentator, while generally agreeing with proposed new § 29.908, objected to its applicability to the entire cooling fan. The commentator stated that there is no service or test history that indicates a need to consider the entire fan. The

FAA believes that the absence of cooling fan failures is due to the requirements of current § 29.1461 which applies to cooling fans that incorporate high energy rotors. In view of the requirements of current § 29.1461 and the fact that there is no service experience of fan failures, the FAA considers that proposed § 29.908 should be revised to be applicable only to cooling fan blade failures. Proposed § 29.908 is revised accordingly.

A commentator stated that loss of cooling may affect the continued safe operation of one or more engines and so prevent continued safe flight. The FAA did not intend to consider the effect of cooling loss but is concerned only with the fragmentation effect of a fan blade failure.

Proposal 3–65. A commentator believed the specification of 15 minutes in proposed § 29.927(c), concerning the loss of rotor drive system oil pressure, was inadequate for category A helicopters which have engine-out capability. Therefore, the commentator indicated, operations are planned over routes where a landing may not be possible within 15 minutes. The intent of the proposal is to enable the pilot to make an autorotative landing after loss of rotor drive system oil pressure and the FAA believes that the proposed 15 minute requirement is adequate for that purpose.

For a discussion of other comments related to proposed § 29.927(c), see the discussion of Proposal 3–53.

Proposal 3–66. A commentator stated that under his interpretation of § 29.965 only a pressure test is required for non-metallic fuel tanks, and he also recommended that slosh testing of non-metallic tanks be added as a requirement. The FAA disagrees. Paragraphs (a), (b), and (c) of § 29.965 apply prescribed pressure tests to all fuel tanks. In addition, § 29.965(d) already applies the slosh test requirement to each tank with large unsupported or unstiffened flat areas, or with other features whose failure or deformation could cause leakage. The proposal is adopted without substanve change.

Proposal 3–67. No unfavorable comments were received on the proposal to amend § 29.991(b). Accordingly, the proposal is adopted without substantive change.

Proposal 3–68. No unfavorable comments were received on the proposal to amend § 29.995. Accordingly, the proposal is adopted without substantive change.

Proposal 3–69. Although there were no unfavorable comments to the proposed amendment of § 29.1093(b) concerning the addition of the inlet system to the consideration required in paragraph (b)(1), the proposal is revised based on a comment to Proposal 3–34. See the discussion for Proposal 3–34.

Proposal 3–70. For a discussion of the revision to § 29.1121(b), see Proposal 3–12.

Proposal 3–71. Although there were no unfavorable comments to proposed § 29.1141(f), the proposal is revised based on a comment to Proposal 3–13. See the discussion for Proposals 3–13 and 3–57.

Proposal 3–72. For a discussion of proposed § 29.1145(c), see Proposals 3–40 and 3–58.

Proposal 3–73. Two commentators objected to the proposal to amend § 29.1193(e) on the grounds that present fire protection requirements for category B rotorcraft are adequate and that the proposal would place an undue weight and cost burden on category B rotorcraft. The FAA disagrees. Service experience has shown that the fire protection requirements specified in § 29.1193(e) should apply to all category of rotorcraft, especially those that may not be required to have fire extinguishing and fire detection systems. The FAA believes that the increase in cost and weight associated with this requirement is justified by the increment of safety attained. The proposal is therefore adopted without substantive change.

Proposal 3–74. No unfavorable comment was received on the proposal to amend § 29.1195. Accordingly, the proposal is adopted without substantive change.

Proposal 3–75. No unfavorable comments were received on the proposal to amend § 29.1197. Accordingly, the proposal is adopted without substantive change.

Proposal 3–76. No unfavorable comment was received on the proposal to amend § 29.1199, and the proposal is adopted without substantive change. Also, see discussion for Proposal 3–43.

Proposal 3–77. For a discussion of the withdrawal of proposed § 29.1305(a)(5), see Proposal 3–59.

Proposals 3–78 and 2–185. Disposition of Proposal 2–185 (Notice 75–10) to amend § 29.1337(a) was deferred so that it could be considered in connection with Proposal 3–78, which is also a proposal to amend § 29.1337(a). No unfavorable comment was received on either proposal. Accordingly, the proposals are adopted without substantive change.

Proposal 3–79. No unfavorable comments were received on the proposal to amend § 33.15. Accordingly, the proposal is adopted without substantive change.

Proposal 3–80. No unfavorable comments were received on the proposal to amend § 33.17. Accordingly, the proposal is adopted without substantive change.

Proposal 3–81. No unfavorable comments were received on the proposal to amend § 35.17. Accordingly, the proposal is adopted without substantive change.

Proposal 3–82. No unfavorable comments were received on the proposal to amend § 35.35. Accordingly, the proposal is adopted without substantive change.

These amendments are made under the authority of sections 313(a), 601, and 603 of the Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423), and of section 6(c) of the Department of Transportation Act (49 U.S.C. 1655(c)).

In consideration of the foregoing, and for the reasons stated in Notices 75–10 and 75–19, Parts 1, 23, 25, 27, 29, 33, and 35 of the Federal Aviation Regulations are amended as follows, effective May 2, 1977.

The Federal Aviation Administration has determined that this document does not contain a major proposal requiring preparation of an Inflation Impact Statement under Executive Order 11821 and OMB Circular A–107.

Amendment 33-9

Airworthiness Review Program—Amendment No. 8A: Aircraft, Engine, and Propeller Airworthiness, and Procedural Amendments

Adopted: August 27, 1980 **Effective: October 14, 1980**

(Published in 45 FR 60154, September 11, 1980)

SUMMARY: These amendments to the Federal Aviation Regulations update and improve the airworthiness standards applicable to the type certification of aircraft, engines, propellers, related operating rules, and procedural requirements. These amendments are part of the Airworthiness Review Program.

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SUPPLEMENTARY INFORMATION:

These amendments are the ninth and last in a series of amendments issued as part of the Airworthiness Review Program. The following amendments have previously been issued as part of this program:

Title and FEDERAL REGISTER (FR) Citation

Amendment No. 1: Form Number and Clarifying Revisions (40 FR 2576; Jan. 14, 1975)

Amendment No. 2: Rotorcraft Anticollision Light Standards (41 FR 5290; Feb. 5, 1976)

Amendment No. 3: Miscellaneous Amendments (41 FR 55454; Dec. 20, 1976)

Amendment No. 4: Powerplant Amendments (42 FR 15034; March 17, 1977)

Amendment No. 5: Equipment and Systems Amendments (42 FR 36960; July 18, 1977)

Amendment No. 6: Flight Amendments (43 FR 2302; Jan. 16, 1978)

Amendment No. 7: Airframe Amendments (43 FR 50578; Oct. 30, 1978)

Amendment No. 8: Cabin Safety and Flight Attendant Amendments (45 FR 7750; Feb. 4, 1980)

These amendments are for the most part based on Notice 75-31 which was published in the FEDERAL REGISTER on July 11, 1975 (40 FR 29410), as well as a number of proposals contained in the following notices of proposed rule making: Notice 75-10 (40 FR 10802; March 7, 1975); Notice 75-19 (40 FR 21866; May 19, 1975); and Notice 75-26 (40 FR 24802; June 10, 1975). Amendments based on the latter three notices have already been issued as a part of the Airworthiness Review Program, specifically those titled Miscellaneous Amendments, Powerplant Amendments, and Airframe Amendments, respectively. Final action on certain of the proposals was deferred, however, at the time the amendments were issued as further consideration and review of these proposals was considered necessary. In other cases, final action was deferred so that they could be considered together with related proposals contained in other notices.

Certain proposals identified as Group 2 in Appendix I to Notice 75-31 were deferred to be dealt with in a later notice as a part of the Airworthiness Review Program. These proposals all addressed the concept of periodically updating the certification basis of airplane models in long-term production. Such recertification every five or ten years would be intended to ensure that the level of safety of all airplanes in service keep pace with the current level of safety expectations. The FAA has now determined that these proposals more appropriately should be examined as a separate issue in a future regulatory action. Accordingly, the proposals identified as Group 2 in Appendix 1 to Notice 75-31 are being dropped from the Airworthiness Review Program.

Proposals relating to cabin safety and flight attendants, which are identified in this amendment, were extracted from Notice 75-31 (40 FR 29410; July 11, 1975) and handled on an expedited basis. Those rules were published in the Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Interested persons have been given an opportunity to participate in the making of these amendments and due consideration has been given to all matters presented. The proposals and comments are discussed below. Substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and further review within the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below, these amendments and the reasons for them are the same as those contained in Notices 75-10, 75-19, 75-26, and 75-31.

DISCUSSION OF COMMENTS

The following discussions are keyed to the like-numbered proposals contained in Notices 75-10, 75-19, 75-26, and 75-31, and are presented in the same order as the corresponding amendments found in the rules portion of this document.

Proposal 8-1. The proposal to amend § 1.1 in order to transfer the definitions for rated power and thrust to a new § 33.6 is withdrawn. It is considered that such a change may introduce confusion in the administration of aircraft certification rules. See also Proposal 8-94.

Proposal 8-2. Several commenters object to proposed § 21.16(a) which would delete reference to a "novel and unusual design feature" as a necessary condition for the Administrator to issue special conditions. Special conditions become a part of the designated applicable regulations for type certification of a particular product (aircraft, aircraft engine, or propeller).

One commenter indicates that the proposed revision is unjustified and would lead to indiscriminate rule making, and that instead of simplifying the administration of the requirements it would introduce complexity. Another commenter claims that adoption of proposed § 21.16(a) would introduce uncertainty into design requirements.

One commenter suggests that in lieu of revising § 21.16, the FAA should perform a study of § 21.21(b)(2). (Section 21.21(b)(2) provides for denial of a type certificate if an unsafe feature or characteristic exists in the design under consideration. Before adoption of § 21.16, FAA used § 21.21(b)(2) to issue special conditions in letter form.) This commenter suggests that if § 21.21(b)(2) were to continue to be used to issue special conditions to cover an unsafe design feature or characteristic that is not "novel or unusual," it must be equally applicable to a condition that exists on more than one (earlier certificated) product, further stating that the other product or products must then have been type certificated using existing rules which did not adequately cover the unsafe design feature or characteristic. On this premise, the same commenter asks several relevant questions. When § 21.21(b)(2) is applied, does the FAA make it retroactive to the other involved models? Are Airworthiness Directives (Part 39) issued? Why wasn't a special condition issued against the first applicant when the condition was, in fact, novel or unusual? Why was this not followed by a notice of proposed rule making for future application?

These comments and questions caused the FAA to completely reevaluate its practices in designating the applicable regulations for type certification under § 21.17(a), commonly referred to as defining a "type certification basis."

After further consideration of the comments received as well as FAA practice in designating the applicable regulations, and the objectives of proposed § 21.16, the FAA agrees that this proposal should be withdrawn because of the potential for possible abuse of general rulemaking procedures, of the requirements of the Administrative Procedure Act, and the intent of Executive Order 12044. As explained below, the objectives of proposed § 21.16 will be satisfied by the application of a new FAA policy affecting the designation of applicable regulations for the type certification of new aircraft, aircraft

engines, and propeller designs. These future practices are consistent with the FAA General Rule-Making Procedures of Part 11, the Administrative Procedure Act, and Executive Order 12044.

Section 21.16 is one paragraph of a number of paragraphs used to define the type certification basis of a new product. Companion paragraphs of importance to this discussion include §§ 21.17 and 21.21. Section 21.17(a) provides that the applicable airworthiness standards are (1) those requirements of this subchapter that are effective on the date of application for a type certificate, unless otherwise specified by the Administrator or unless compliance with later effective amendments is elected by the applicant or required by special retroactive regulations (e.g., § 25.2), and (2) any special conditions prescribed by the Administrator in accordance with § 21.16. Section 21.16 provides for the issuance of special conditions when the Administrator finds that the existing airworthiness standards do not contain adequate or appropriate safety standards *because of novel or unusual design features* of the product to be type certificated. Section 21.21(b) (1) permits noncompliance with specific provisions of the airworthiness standards when there are compensating factors that provide an equivalent level of safety. Such determinations are commonly referred to as "equivalent safety findings." Section 21.21(b) (2) provides for the denial of a type certificate, notwithstanding a showing of compliance with the applicable airworthiness standards designated in accordance with § 21.17, if the Administrator finds an unsafe feature or characteristic of the product for the category in which certification is requested.

Sections 21.16, 21.17, and 21.21, taken together with FAA policy in designating the applicable regulations must recognize and balance four important considerations: (1) the FAA has an obligation under Section 601 of the Federal Aviation Act of 1958 to keep the airworthiness standards of this subchapter (i.e., FARs 23, 25, 27, 29, 31, 33, and 35) as current as practicable; (2) the type certificate applicant has a right and a need to know, in very specific terms, what the applicable airworthiness standards will be in order to finalize the detail design of its product and to enable the applicant to make reasonable performance guarantees to its potential customers; (3) in the interests of safety, rapid technological advances presently being made by the civil aircraft industry require that the FAA be able to issue special conditions to address truly novel or unusual design features that it has, as yet, not had an adequate opportunity to envisage in the airworthiness standards through the general rulemaking process; and (4) because the airworthiness standards of this subchapter are intentionally objective in nature to allow flexibility in design, the FAA must retain the prerogatives both to make equivalent safety findings and to deny a type certificate whenever an unsafe design feature or characteristic is found during the type certification process.

The phrase "novel or unusual" as used in § 21.16 is a very relative term. As used hereafter in applying § 21.16 to justify the issuance of special conditions, "novel or unusual" will be taken with respect to the state of technology envisaged by the applicable airworthiness standards of this subchapter. It must be recognized that in some areas which will vary from time to time the state of the regulations may somewhat lag the state of the art in new design because of the rapidity in which the state of the art is advancing in civil aeronautical design and because of the time required to develop the experience base needed by the FAA to proceed with general rule making. Applicants for type certification of a new design have the opportunity to mitigate the impact of not knowing the precise airworthiness standards to be applied for "novel or unusual design features" by consulting with the FAA early in their certification planning when such features are suspected or known by the applicant to exist. It should also be recognized that, because of the intentional objective nature of the airworthiness standards of this subchapter, many new design features which might be thought of as "novel or unusual design features" may already be adequately covered by existing regulations, thus obviating the need to issue special conditions.

Henceforth, the special condition will not be issued for general upgrading of the applicable airworthiness standards when novel or unusual design features are not

involved. Whenever the FAA determines that an upgrading of the airworthiness standards of this subchapter is warranted, the upgrading will be promulgated as an amendment to this subchapter consistent with the general rulemaking procedures of FAR Part 11, the Administrative Procedure Act, and Executive Order 12044. Should the FAA conclude that there is a compelling safety need to apply a proposed amendment retroactively to designs already type certificated or to designs for which a type certificate application is in progress, the retroactive aspects of the proposed amendment, if supportable by a regulatory analysis completed in accordance with Executive Order 12044, will be announced in the notice or proposed rule making for that amendment. Public comments on the proposed retroactive aspects will be considered in determining the applicability of the adopted rule.

A number of products for which special conditions have not as yet been issued are undergoing type certification at the time of this amendment. Should the FAA conclude that recent or future amendments to this subchapter should be applied to these products that would not otherwise be applicable under § 21.17(a) (1) then an amendment to require retroactive application will be proposed and acted upon through the general rulemaking process explained above, in lieu of issuing special conditions under § 21.16.

Also, the provisions of § 21.21(b) (2) will no longer be used to justify the issuance of special conditions. However, just as an Airworthiness Directive may be issued under Part 39 to require the correction of an unsafe condition that is likely to exist or develop in a product of the same type design, notwithstanding a showing of compliance with the applicable airworthiness standards, § 21.21(b) (2) may continue to be used to deny issuance of a type certificate if a similar unsafe feature or characteristic is found during the type certification process, notwithstanding a showing of compliance with requirements designated by § 21.17. The unsafe features and characteristics envisaged by § 21.21(b) (2) are those related to specific design configuration or product characteristics of a particular design, that one would not normally expect the applicable airworthiness standards to specifically preclude because of their intentionally objective nature.

It is the practice of the FAA to develop and publish a Type Certificate Data Sheet as an integral part of each type certificate. The type certification basis is recorded on the Type Certificate Data Sheet for public information. In the future the type certification basis statement will identify not only the applicable regulation, including special conditions, but also will identify all exemptions issued pursuant to Part 11, together with "equivalent safety findings" made in accordance with § 21.21(b) (1).

For the above reasons, Proposal 8-2 is withdrawn.

In considering its disposition of the proposal to amend § 21.16(a), the FAA realizes that a "novel or unusual design feature" today may become a common design feature of the future. The issuance of a like special condition for several product designs will most likely compel general rule making on that subject and the history of that special condition could have a very strong influence on thinking when general rule making is initiated. Also, although special conditions are regulations of particular product applicability, they are issued only in the interest of public safety. For these reasons, Part 11, and § 21.16 of Part 21 are amended to require special conditions to be issued in accordance with the existing general rule-making procedures. As is now the case, a docket will continue to be maintained for each set of special conditions, and all material in the docket will continue to be available for public review.

Proposal 8-3. This proposal is one of a group of proposals dealing with the establishment of Instructions for Continued Airworthiness and the responsibilities of maintenance personnel and aircraft operators with respect to those instructions. The group is made up of the following proposals: 8-3, 8-5, 8-21, 8-25, 8-58, 8-62, 8-64, 8-67, 8-77, 8-80, 8-89, 8-91, 8-92, 8-93, 8-97, 8-98, 8-99, 8-104, 8-106, 8-107, 8-110, and 8-111.

A commenter representing a number of scheduled air carriers objects to the requirement in § 21.31(c) that the type design include the Airworthiness Limitations

section of the Instructions for Continued Airworthiness because of the information to be included in that section. Although this commenter does not object to including mandatory replacement times for life-limited parts in the Airworthiness Limitations section, the commenter strongly objects to including inspection intervals and related procedures. Under proposed §§ 43.16 and 91.163(c), the commenter points out, air carriers would be required to comply with these maintenance-related airworthiness limitations. The FAA does not agree that inspection intervals and related procedures can be omitted from the Airworthiness Limitations section of the Instructions for Continued Airworthiness. For example, the proposed Airworthiness Limitations section on a transport category airplane must contain mandatory inspection intervals and related procedures because the damage-tolerance concept described in § 25.571 is predicated upon the use of such inspections to detect initial cracks in principal structural elements before crack growth under repeated loads could progress to a degree which would cause catastrophic failure of the airplane. However, the FAA does agree that §§ 43.16 and 91.163(c) should permit modification of these intervals and procedures by other FAA approved methods. Accordingly, inspection programs approved under §§ 121.25(b), 121.45, 121.367, 123.21(b), 127.13(b), 127.133, 135.5, 135.17, 135.419, 135.421, and 135.425, as defined by approved operations specifications, or an inspection program approved under § 91.217(e) constitute acceptable alternatives. The appendices to Parts 23, 25, 29, 31, 33, and 35 as adopted in this amendment require the applicant to specify (in the Airworthiness Limitations section) mandatory replacement times, inspection intervals, and related procedures. Sections 43.16 and 91.163(c) have been revised to show that only the inspection times and procedures may be adjusted under approved alternative programs.

A commenter objects to § 21.31(c), which in general is applicable to manufacturers, since continued airworthiness, which is covered in the paragraph, is the responsibility of the operator. Because this comment pertains more directly to § 21.50, it is dealt with in conjunction with Proposal 8–5.

In addition to comments relating to the Instructions for Continued Airworthiness, a commenter objects to § 21.31(a) because the proposal to include a list of drawings and specifications in the type design was not mentioned at the Airworthiness Review Conference. In fact, this proposal did appear as an FAA comment on Proposal No. 565 in the Committee I Workbook (titled "Procedures and Special Subjects") made available to all participants at the conference, and may be found in the docket.

Several commenters object to § 21.31(d) because including analyses in the type design—(1) would be redundant, since it is already required as part of the substantiating data; (2) is unnecessary, since the drawings and specifications required under current § 21.31(a) provide the general information needed by the FAA; and (3) introduces the possibility that the FAA would require the manufacturer to provide any and all data used to prepare the drawings and specifications, thereby delaying type certification. The FAA agrees that proposed § 21.31(d) would serve no useful purpose and it is withdrawn.

Proposal 8–4. A commenter objects that § 21.35(b) (2) eliminates flight testing for reliability, contending that analysis and ground test are not dependable as a basis for certification. In the light of this comment, and after further consideration and experience, the FAA has determined that flight testing for reliability does provide safety information not necessarily obtainable from analysis and ground test. Accordingly, the proposal to delete the reference to reliability in § 21.35(b) (2) is withdrawn.

No adverse comment was received on the proposal to replace the word "airplanes" in § 21.35(b) (2) with the word "aircraft" and this amendment to § 21.35(b) (2) is adopted without change.

Proposal 8–5. A commenter objects to the continued airworthiness provisions of § 21.50(b) (and also proposed § 21.31(c)) contending that—(1) continued airworthiness is the responsibility of the operator/owner; (2) current regulations in Parts 23 and 25 already require manufacturers to make available recommended maintenance procedures for the product at the time of its delivery; (3) current operating rules require the operator/owner to establish and comply with a maintenance program; and (4) with respect

to transport airplanes, the present FAA Maintenance Review Board (MRB) system is an entirely satisfactory way of establishing the means for maintaining airworthiness. Current FAA practice allows operators of new transport category airplanes to utilize FAA MRB recommendations (reference FAA Advisory Circular No. AC 121-22) for starting their maintenance programs, and then vary them with FAA approval as experience and operating conditions dictate. The commenter points out that, contrary to that practice, the amendment will require the manufacturer to obtain FAA approval of its recommended maintenance procedures before the airplane is type certificated, and to obtain FAA approval of revisions to those procedures (necessitated by any improvement change in the airplane) before approval of the change itself. This, the commenter states, will impose a severe and unnecessary hardship on the manufacturer.

On the first and second points, although the operator/owner does have responsibility for continued airworthiness, the FAA has found that the recommended maintenance procedures made available under current regulations are frequently inadequate in scope and content, and often do not provide a sound basis for the operator/owner to maintain the airworthiness of the aircraft. The FAA has concluded that the lack of such recommended maintenance procedures can best be remedied by requiring that they be made available to owners and operators by the type certificate or supplemental type certificate holder. On the third point, while it is true that not all operators/owners are required to establish and comply with a continuous airworthiness program, those that voluntarily wish to set up such a program are often handicapped by the lack of comprehensive instructions, which would be remedied by § 21.50(b). On the other hand, those required to establish a program will benefit from the more detailed and comprehensive instructions made available to them under § 21.50(b). On the fourth point, which is directed toward aircraft that will be maintained in accordance with an FAA approved operations specification and maintenance program under Parts 121, 123, 127, 135, or an approved inspection program under § 91.217(e), the FAA recognizes that these procedures for maintaining airworthiness of the products have functioned satisfactorily. In this regard, the FAA expects that operating segments of the air transportation industry would continue to work with type certification applicants in defining adequate maintenance instructions prior to type certification. The FAA MRB document, which is a product of contributions made by both the operators and manufacturer, could be picked up by the type design holder and included as a part of the required Instructions for Continued Airworthiness, thus continuing the usefulness of the existing MRB practices for the original entry into service of new product designs. Likewise, the additional maintenance instructions that would be required and which are not typical to MRB documents, but are presently required in air carrier operators' FAA approved maintenance programs, could also be picked up by the type design holder. Therefore, the screening process that would be utilized by the FAA in reviewing such maintenance documents would not unnecessarily delay type certification or approval of design changes after certification. See also the discussion under Proposal 8-3.

A commenter questions the need for the provision in § 21.50(b) requiring that the Airworthiness Limitations section of the Instructions for Continued Airworthiness be furnished with each aircraft, engine, or propeller. The FAA agrees that this provision is unnecessary, as the type certificate holder must make the manual available, and the operator/owner must comply. To require a manual to be furnished with each equipment would be redundant, and in some instances, would be unnecessary. Accordingly, the requirement that the Airworthiness Limitations section be furnished with each airplane or product is revised to require that the section be furnished to each owner of the type.

A commenter objects to § 21.50(b) insofar as it applies to rotorcraft type certificated under Parts 27 and 29, contending that the manufacturer is already required under those parts to furnish a maintenance manual, which has allegedly been proven adequate. The FAA does not agree. The proposed Instructions for Continued Airworthiness, which are broader in scope and more detailed than the maintenance manual currently required under Parts 27 and 29, would provide the operator/owner with the minimum amount of

information needed to maintain the airworthiness of increasingly complex rotorcraft currently being designed.

A commenter suggests that § 21.50(b) be revised to make it clear that an aircraft manufacturer need not supply Instructions for Continued Airworthiness pertaining to engines and propellers until the complete aircraft is delivered to the first retail purchaser. The continued airworthiness instructions for propellers and engines should be provided to the aircraft manufacturer to facilitate transmittal to purchasers of the aircraft.

A commenter notes that § 21.50(b) would require an aircraft manufacturer to make the Instructions for Continued Airworthiness available to the owner upon delivery of the aircraft and to any other person required to comply with any of the terms of those instructions *upon request.* Since such a request could be made before the first aircraft delivery, it could impose an unnecessary burden on the aircraft manufacturer. The commenter suggests that § 21.50(b) be revised so that such a request need not be filled until after delivery of an aircraft to the first owner. The FAA agrees that an early request for the Instructions for Continued Airworthiness could impose an unnecessary burden on the manufacturer. Additionally, the FAA notes that airplanes can be delivered to an operator, prior to full type certification, with a provisional airworthiness certificate to allow activities such as crew training, and therefore prior to the approval of the Airworthiness Limitations section. Accordingly, the phrase "upon request" has been deleted from § 21.50(b) and the language has been revised to require that at least one set of the complete Instructions for Continued Airworthiness be furnished upon delivery to the customer, or subsequent to issuance of the first standard certificate of airworthiness, whichever occurs later.

Proposal 8-6. Commenters object to the proposal to make § 21.97(b) applicable to all products rather than to engines only because—(1) the volume of paperwork would increase out of proportion to any benefits that might be gained; (2) the applications for supplemental type certificates would be significantly more complex, since there are frequently many configuration variations within an aircraft model and a fleet operator would have to list all of the configurations or make separate application for each; and (3) the term "specific configuration" must be defined if the proposal is to be properly administered. In light of these comments and after further consideration, the FAA concludes that this proposal requires additional study and it is withdrawn.

Proposal 8-7. No unfavorable comment was received on the proposal to amend § 21.123 to require a manufacturer to submit a manual describing its production inspection system and means for controlling materials and parts. Accordingly, the proposal is adopted without substantive change.

Proposal 8-8. A commenter objects to § 21.143(a)(2) contending that substitution of the word "supplier" for "subsidiary" introduces a major change to the requirements, involving increased paperwork and costs. The FAA does not agree. The FAA has consistently administered § 21.143(a)(2) as applying to *all* raw materials, purchased items, parts, and assemblies supplied to the prime manufacturer. The change does not involve increased paperwork or costs because it is a semantic change which clarifies the definition of persons or entities subject to the quality control data requirements of § 21.143, without expanding any of those requirements. The use of the term "subsidiary" is unclear because it implies that there must be a corporate connection between the prime manufacturer and his supplier. Accordingly, the language has been revised to reflect the FAA's intent that the quality control data requirements of § 21.143(a)(2) apply to all "suppliers" of each prime manufacturer. For similar reasons and for internal consistency, § 21.143(b) is revised to replace the term "subsidiary manufacturers" with the term "suppliers".

Proposal 8-9. No unfavorable comment was received on the proposal to amend § 21.182 to ensure that the proposed new § 45.11(c) is cross referenced. Accordingly, the proposal is adopted without substantive change.

Proposal 8-10. A commenter raises the question whether a special flight permit issued under § 21.197(a) (3) would serve as a certificate of airworthiness for international flights. The FAA notes that international flights cannot be conducted under special flight permits issued under § 21.197 unless specifically authorized by the foreign authorities concerned.

Another commenter objects to § 21.197(a) (3) (ii) because as worded, the individual aircraft would have to be flown for at least 50 hours, thereby defeating the purpose of the original proposal (as submitted for the Airworthiness Review) which aimed at eliminating unnecessary delays in obtaining FAA approval of customer demonstration flights. The commenter suggests that this provision be changed to stipulate that the aircraft type must have been flown for at least 50 hours. The FAA agrees that since the proposal concerns aircraft manufactured under a production certificate, and since the aircraft type could have been flown for at least 50 hours during the type certification program, the 50 hours of flight provision is not necessary. However, the FAA does not agree with the commenter's suggested revision. It is necessary to require that production flight tests for the individual aircraft involved be satisfactorily completed before that aircraft is flown on customer demonstration flights. Accordingly, § 21.197(a) (5) is added to prescribe this condition in place of the 50 hours of flight provision.

The same commenter also suggests that § 21.197(a) (3) (ii) should be made applicable to aircraft produced under a type certificate only, since such aircraft received close production surveillance by the FAA. The FAA agrees that a production certificate should not be the limiting factor in obtaining FAA approval of customer demonstration flights. If the aircraft has been demonstrated to otherwise meet all the safety requirements for a standard airworthiness certificate, then customer demonstration flights could be permitted. This proposal is adopted by the addition of § 21.197(a) (5).

In addition, the commenter suggests that proposed § 21.197(a) (3) (ii) be amended with a reference to the maintenance and inspection programs called for under § 21.195 for Experimental and Subpart C Provisional Type Certificates. Such procedures would unnecessarily complicate the issuance of permits for customer demonstration flights and would in effect nullify the original proposal. The portion of the proposal calling for maintenance and inspection programs in these instances is therefore withdrawn.

Proposal 8-11. No unfavorable comments were received on the proposal to amend § 23.253(b) (3) to ensure that high speed buffeting does not become severe enough to prevent the pilot from reading the instruments or controlling the airplane. Accordingly, the proposal is adopted without substantive change. Also see Proposal 8-28.

Proposal 8-12. No unfavorable comments were received on the proposal to amend § 23.361 to redefine the limit engine torque load conditions to be considered for turbine engine installations and to make other clarifying changes. Accordingly, the proposal is adopted without substantive change.

Proposal 8-13. The FAA does not agree with a commenter who suggests that the lead-in of § 23.371 be revised to make the gyroscopic load requirements applicable to piston as well as turbine engines. The FAA has no information to indicate a need for coverage of piston engines in this regulation, nor was any submitted by the commenter.

Another commenter concurs with § 23.371, assuming that a rational analysis of loads under § 23.371(a) is an alternate to the loads specified in § 23.371(b). This assumption is correct. No change to § 23.371 was proposed in this regard. Section 23.371 is adopted without substantive change.

Proposal 8-14. A commenter suggests that the word "operated" in § 23.729(c) be replaced by the word "lowered". The commenter states that the intent of the rule is to ensure that the gear can be lowered in an emergency. The FAA concurs, but the word "extended" is used to preserve the internal consistency of the section. Section 23.729(c) is revised accordingly.

This commenter also questions whether § 23.729(e) would require an "up lock". The commenter is evidently referring to a "lock" in the sense of a positive means other than hydraulic pressure, as required to keep the gear extended by § 23.729(b). Section 23.729(e) contains no such requirement.

Another commenter suggests that the second sentence of § 23.729(e) be revised to add the words "and secured" after the words "fully extended" and "fully retracted" in order to clarify what functions the lights would indicate to the pilot. The first sentence of the paragraph clearly states that the indicators should inform the pilot that the gear is secured in the extended or retracted position.

A commenter states that the proposal is redundant since the requirement is already in effect. The FAA does not agree. This is one of several new provisions being incorporated into the current regulations to assure the reliability of small land-plane landing gear systems.

After further review, the FAA has determined that the words "and warning device" should be removed from the heading of § 23.729(e) to preclude confusion between the requirements of this paragraph and those of § 23.729(f). Section 23.729 is adopted with editorial changes and the revisions discussed.

Proposal 8–15. A commenter objects to § 23.903(f) on the grounds that it imposes new and unjustified criteria for restart capability of reciprocating engine powered airplanes. The FAA believes the requirement to be fully justified. Accidents have occurred with multiengine reciprocating powered, as well as turbine powered airplanes because pilots have not been adequately apprised of the engine restart envelope for their airplane. Therefore, the requirement must apply to both types of engine installations.

This commenter further states that § 23.903(g) is acceptable provided that the "restart requirement is understood to be within the restart envelope for the aircraft (if one is approved for the aircraft)." Present § 23.903(e) (3), as applicable to turbine engine powered small airplanes, states that it must be possible to restart an engine in flight, and § 23.903(f) requires that an approved restart envelope be established. Therefore, development of a restart envelope would be required for the approval of each turbine engine powered small airplane. As adopted, § 23.903(g) requires that, following in-flight shutdown of all engines, electrical power for ignition exists throughout the approved restart envelope.

Another commenter states that it seems inconsistent to require that electrical power be provided for ignition but not for rotational capability sufficient for an engine start. The FAA does not agree. As adopted, the rule provides for those circumstances where engine windmilling speed is sufficient for restarting but insufficient to provide electrical power for ignition.

The proposal is adopted without substantive change. However, § 23.903(f) is revised to make it clear that the specified in-flight engine restart capability is required throughout the required altitude and airspeed envelope.

Proposal 8–16. No unfavorable comment was received on adding a new § 23.905(d) referencing propeller blade pitch control system durability requirements. Accordingly, § 23.905(d) is adopted without substantive change. For discussion of a related proposal to add a new § 35.42, see the discussion under Proposal 8–103.

Proposal 8–17. A commenter suggests that since the requirement for fuel tanks to retain fuel during a landing with landing gear retracted or collapsed may be subject to individual interpretation, advisory material on compliance methods should be reviewed with industry prior to implementation of the rule. The FAA does not agree. The revision merely clarifies an existing requirement. Section 23.967 is adopted without substantive change.

Proposal 8–18. A commenter recommends that the proposal to add a new § 23.991(d) which requires that operation of any fuel pump does not adversely affect continuous engine operation, be withdrawn or its adoption delayed while the compatibility of engine and airplane fuel systems is studied. The compatibility between these systems must be established in the design process, and the relevant design considerations are well known. Delaying the requirement in favor of additional study is not warranted.

Another commenter contends that the requirement is beyond the needs of safety. The FAA agrees that the proposed requirement is too restrictive and § 23.991(d) is revised to provide that the operation of any fuel pump may not affect engine operation so as to create a hazard.

Two commenters disagree with adding a new § 23.991(d), contending that it eliminates present fuel system designs. The FAA has no information to suggest that compliance with the revised section, as discussed above, would be impossible using present fuel system designs, nor was any presented by the commenter.

The proposal is adopted with the revision discussed above.

Proposal 8–19. No unfavorable comments were received on the proposal to amend § 23.1305(n) to permit movement of the propeller blade up to 8° below the flight low pitch position before an indication of the movement is required for the flight crew. Accordingly, the proposal is adopted without substantive change.

Proposal 8–20. For comments related to withdrawal of the proposal to revise § 23.1521(a), see Proposal 8–94.

Proposal 8–21. Since the proposal for § 23.1529 is substantively identical to those for §§ 25.1529 (Proposal 8–58), 27.1529 (Proposal 8–64), and 29.1529 (Proposal 8–77), all comments on these proposals are considered here.

A commenter notes that although the explanation for § 23.1529 makes it clear that the Instructions for Continued Airworthiness need not be finalized until delivery of the first airplane, the proposal itself seems to require that they be finalized before type certification. The commenter suggests that this point be clarified. The FAA agrees, and §§ 23.1529, 25.1529, 27.1529, 29.1529, 31.82, 33.4, and 35.4, are revised accordingly.

In response to a commenter representing a group of scheduled air carriers, the FAA notes that, except for the Airworthiness Limitations section, there is no requirement that any operator/owner use the Instructions for Continued Airworthiness referred to in §§ 23.1529, 25.1529, 27.1529 and 29.1529. Moreover, the new §§ 43.13(a), 43.16, and 91.163(c) allow the use of other methods. In particular, the use of maintenance manuals and continuous airworthiness maintenance programs developed under current Parts 121, 123, 127, and 135, or an inspection program approved under current § 91.217(e), would be acceptable alternatives to the Airworthiness Limitations section. This commenter suggests that language be added to § 25.1529 to make it clear that alternatives to the Instructions for Continued Airworthiness (except the Airworthiness Limitations section) may be used. This suggestion was not adopted because §§ 43.16 and 91.163(c) make this provision sufficiently clear.

Proposal 8–22, 8–23, and 8–24. Final action on Proposals 8–22, 8–23, and 8–24 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; Oct. 30, 1978).

Proposal 8–25. The proposals to add an appendix to Parts 23, 25, 27, and 29 (Proposals 8–62, 8–67, and 8–80) setting forth Instructions for Continued Airworthiness are substantively identical and are discussed below. Unless otherwise stated, the discussion refers to the designated sections in each of the appendices mentioned above.

§ *XX.1(a).* A commenter objects to the concept of specifying requirements (as opposed to providing guidance) for the preparation of Instructions for Continued Airworthiness, contending that such requirements would lead to time-consuming negotiations between the manufacturer and the FAA, and that some flexibility in providing the instructions is necessary. The appendix sets forth, in broad objective terms, the *kinds* of information the Instructions for Continued Airworthiness must contain. Within this framework, the manufacturer would be free to develop detailed instructions appropriate to its aircraft. The FAA is confident that the appendix provides a reasonable measure of flexibility, and anticipates no difficulties or delays in determining the acceptability of the Instructions developed by the manufacturer.

§ *XX.1(b).* A commenter objects to the requirement that Instructions for Continued Airworthiness be provided for appliances, contending that—(1) this information is often not available from the appliance manufacturer; (2) even when available, the information sometimes has to be revised for the particular application in a manner not approved or intended by the appliance manufacturer; and (3) the information necessary for customized equipment installations would be unreasonably costly to develop. The FAA does not agree. Such information, which is essential to the continued airworthiness of the aircraft, should be provided for each required product. Accordingly, the language of § XX.1(b) is revised to make it clear that if the aircraft manufacturer does not supply continued airworthiness instructions for the product, the Instructions for Continued Airworthiness for the aircraft must include this information. See also the discussion under § XX.3(a) (5) (i).

A commenter objects to the proposal to include information on engines and all appliances in the Instructions for Continued Airworthiness, contending that—(1) such information should be furnished by the engine or appliance manufacturer; and (2) with respect to appliances, only those for which standards have been established by FAA should be covered. On the first point, manufacturers of new engine designs are required to supply the information for their products under new § 33.4. Manufacturers of new aircraft using currently certificated engines are required by § XX.1(b) to provide the information for the engine in their Instructions for Continued Airworthiness for the aircraft. In practice, the FAA expects this information to be developed and supplied by the engine manufacturer. A similar requirement for appliances would be administratively impracticable because of the large number involved. On the second point, it should be noted that specific performance and safety standards have not been established for all essential appliances. However, upon further review, the FAA concludes that it would be unreasonable to require the aircraft manufacturer to cover appliances other than those required in applicable regulations. Accordingly, § XX.1(b), as adopted, refers only to appliances "required by this chapter."

§ *XX.2.* A commenter suggests a revision of this section to make clear that the Instructions for Continued Airworthiness may consist of a series of volumes, or may be supplied in other than book form, such as on microfilm or microfiche. The language in § XX.2 is sufficiently broad to cover these acceptable alternatives. Reference to the Air Transportation Association of America Specification No. 100 (where it appeared) is deleted from § XX.2(b) because it is nonregulatory.

§ *XX.3, lead-in paragraph.* A commenter objects to the requirement that the contents of the manual "be prepared to be understood by the persons who will be responsible for maintaining" the aircraft or product, contending that—(1) it would impose a subjective standard that would be impossible to meet; and (2) it could be interpreted to mean that, in some circumstances, manuals for aircraft to be exported must be prepared in the language of the country of export. In light of these comments, the first sentence of the lead-in paragraph of § XX.3, is revised to read as follows: "The contents of the manual or manuals must be prepared in the English language." This conveys the intent of the original proposal. A commenter points out that there may be different levels of maintenance instructions, directed at different classes of operators. For example, the maintenance instructions provided to a fleet operator or commuter airline may be more comprehensive than those provided to a fixed base operator. Any level of maintenance instructions considered appropriate by the manufacturer may be submitted, provided that those instructions comply with the minimum standards in the appendix.

§ *XX.3(a) (2).* A commenter recommends that the requirement for complete descriptions be limited in scope to the "standard" aircraft and "quantity-installed" optional equipment, contending that it would be virtually impossible to devise "custom" maintenance manuals for each product because of the many combinations of equipment that may be ordered by the purchaser. In addition, the commenter states that a manual containing all of these combinations would be difficult to use. The FAA does not agree. To achieve its purpose, the Instructions for Continued Airworthiness must contain information on each item of equipment required by regulation to be installed on the

aircraft. The FAA notes that supplemental type certificates (STC's) are required for installation of equipment not a part of the type certificate, and that this maintenance manual requirement is equally applicable to the STC applicant.

§ XX.3(a) (3). A commenter recommends that since maintenance personnel have no need for the kind of operating information provided in a Pilot's Operating Handbook, the paragraph be revised to require only *basic* principles of equipment control and operation. The FAA agrees, and § XX.3(a) (3) now refers to "basic control and operation information."

§ XX.3(a) (5) (i). A commenter recommends that applicants be allowed to refer to a component manufacturer as a source of information instead of including the information in the Instructions for Continued Airworthiness. The commenter argues that many component manufacturers prefer to maintain control of their maintenance information to ensure that it is up to date. In other cases, maintenance at the factory may be required because of the complexity of the equipment. The FAA recognizes that some accessories, instruments, and equipment have an exceptionally high degree of complexity, requiring specialized maintenance techniques, test equipment, or expertise. In such cases, it would be in the interest of safety to allow the applicant to refer to the appropriate manufacturer in the maintenance instructions. The FAA does not agree, however, that such reference should be allowed in other circumstances. Section XX.3(a) (5) (i) (redesignated § XX.3(b) (1)) is revised accordingly.

A commenter recommends that the last sentence of § XX.3(a) (5) (i), be revised to allow reference to a separate inspection program, rather than include it in the maintenance instructions, so that the inspection program could be better kept current and also tailored to an individual operator's needs. The FAA does not agree. The inspection program must be set forth in the Instructions for Continued Airworthiness to ensure its availability to those who will benefit from it.

The FAA, after further study of § XX.3(a) (5) (i), has decided that the provision should specifically require a description of applicable maintenance or wear tolerances. Section XX.3(a) (5) (i) (redesignated § XX.3(b) (1)) is clarified in this regard.

§ XX.3(a) (5) (ii). A commenter objects to the words "could occur" in this paragraph because it encompasses everything within the realm of possibility, thereby unnecessarily increasing the volume of the maintenance instructions. The phrase "probable malfunctions" replaces the phrase "typical malfunctions that could occur" in § XX.3(a) (5) (ii) (redesignated § XX.3(b) (2)).

§ XX.3(a) (5) (iii). A commenter suggests that this paragraph would be clearer if the first three words and the last five words are deleted. Section XX.3(a) (5) (iii) (redesignated § XX.3(b) (3)) is revised accordingly.

§ XX.3(a) (5) (iv). A commenter suggests revision of this paragraph to make it clear that the overweight landing check refers to the condition in which a certificated landing weight is lower than certificated takeoff weight, since the aircraft manufacturer cannot speculate what damage might be done to an aircraft that takes off and must immediately land at a weight near the certificated takeoff weight. This comment may have merit for certain aircraft. Moreover, since an overweight landing is but one of several occurrences which would necessitate a check to determine aircraft damage, to single out one occurrence would imply that the others need not be covered in the maintenance instructions. Accordingly, the words "checks after an overweight landing" are deleted from § XX.3(a) (5) (iv) (redesignated § XX.3(b) (4)).

§ XX.3(b). A commenter recommends deletion of the requirement for an overhaul manual or section, contending that—(1) there are many products that, for safety reasons, should not to be overhauled; and (2) the manufacturer must make the technical assessment as to whether a product can be safely overhauled. In the light of these comments, and after further consideration, the FAA finds that those portions of § XX.3(b) that provide for overhaul information only (except for engines), should not be required in the Instructions for Continued Airworthiness. Accordingly, §§ XX.3(b) (1) (i), XX.3(b) (1) (ii),

XX.3(b) (1) (iv), XX.3(b) (1) (viii), and XX.3(b) (3), are withdrawn. The other provisions of § XX.3(b) specify information that is needed for purposes other than overhaul.

§ XX.3(b) (1) (iii). No adverse comment was received on this proposal to require structural access plate information. Accordingly, it is adopted as proposed, but redesignated § XX.3(c).

§ XX.3(b) (1) (v). No adverse comment was received on this proposal to require instructions on special inspection techniques. Accordingly, it is adopted as proposed, but redesignated § XX.3(d).

§ XX.3(b) (1) (vi). A commenter points out that no part can be restored to its original condition by protective coatings or treatments. The FAA agrees, and § XX.3(b) (1) (vi) (redesignated § XX.3(e)) is revised to make this clear and to require only the information necessary to apply protective treatments to the structure after inspection.

§ XX.3(b) (1) (vii). No adverse comment was received on this proposal to require data on structural fasteners. Accordingly, it is adopted as proposed, but redesignated § XX.3(f).

§ XX.3(b) (1) (ix). No adverse comment was received on the proposal to require a list of special tools. Accordingly, it is adopted as proposed, but redesignated § XX.3(g).

§ XX.3(c). Three commenters object to the concept of supplying generalized repair data. One contended that—(1) the nature of the damage may not be known in a particular case, though it may appear to fall under a general repair "fix"; (2) the safety of the product may be seriously impaired by repairs made in such instances; and (3) the manufacturer can provide alternate means for a mechanic to obtain repair data. In the light of these comments, the FAA agrees that it is not necessary to include the repair information in the Instructions for Continued Airworthiness as proposed. Accordingly, proposed § XX.3(c) is withdrawn.

§ XX.4. A commenter suggests that the manufacturer should be allowed to list items in the Airworthiness Limitations section that it deems necessary to maintain structural integrity, where such items are not called out in the applicable airworthiness standards. Another commenter, representing the scheduled airlines, objects to the inclusion, in the Airworthiness Limitations section, of mandatory replacement times for parts other than life-limited parts and of mandatory inspection intervals. The resolution of these comments is discussed under Proposal 8–3. The language proposed for the Airworthiness Limitations sections of the appendices to Parts 23, 25, 27, and 29 is being retained, except that the mandatory replacement times, mandatory inspection intervals, and related procedures are specified as those associated with structural integrity—including those approved under current § XX.571. It also is made clear that FAA approved alternative programs may be used. To avoid unnecessary restriction being placed on operation, only these items are listed in the pertinent Airworthiness Limitations section. Other items can of course be listed in other sections of the Instructions for Continued Airworthiness.

Proposal 8–26. The addition of new §§ 25.101(i) and (j) would set forth requirements for automatic systems that affect performance, including automatic takeoff thrust control systems (ATTCS). In view of the evolving technology of automatic systems, the special features and functions of each design, and the complex interrelationships with other systems, the FAA has concluded that specific regulations are premature and that safety considerations can be more advantageously addressed in special conditions for specific systems. Accordingly, Proposal 8–26 and related Proposals 8–34, 8–48, and the § 25.1305(c) (9) portion of 8–50 are withdrawn.

Proposal 8–27. The revision of § 25.111(c) (4) will permit changes in power or thrust by an automatic takeoff thrust system but prohibit any change requiring action by the pilot when determining the takeoff path. Although specific proposals relating to criteria for automatic takeoff thrust systems have been withdrawn, the FAA believes that this proposal should be retained as it standardizes the procedure for determining the takeoff path, and is consistent with current practice.

One commenter implies that this rule change will add the task of monitoring conditions and instruments and thereby increase the pilot workload. Other commenters suggest that a limited provision for manual throttle setting be included, or are opposed to the proposal completely on the grounds that safety will be compromised in service. Since the rule will apply in the context of a determination of performance rather than an operating requirement, the proposal is adopted without change.

Proposal 8–28. A commenter suggests that the term "impair" in § 25.253(a) (2) (iii) be changed to "significantly impair". The FAA does not agree. In present high altitude, high Mach number jet airplanes, any recovery from upset or speed anomaly must be done essentially by reference to flight instruments. Therefore, any buffet or vibration condition which would in any way impair the pilot's ability to accurately interpret instrument information cannot be tolerated. The same commenter stated that some interpretative material on vibrational frequencies and levels of acceleration would be useful. Use of interpretative material would divert attention from the primary consideration, impairment of pilot ability, which is qualitative. Proposed § 25.253(a) (2) (iii) is adopted without substantive change.

Proposal 7–17. Although no unfavorable comment was received on the proposal to amend § 25.305(d), two commenters state that their agreement was with the understanding that both the discrete gust and the continuous turbulence analyses are required. Present § 25.341(a) requires that limit load factors be established by reference to a discrete gust encounter. Present § 25.305(d) specifies that the dynamic response of the airplane to vertical and lateral continuous turbulence must be taken into account. Both analyses are required.

Two commenters recommend that present § 25.341 be amended to require dynamic loads analysis by reference to discrete gusts having varying gust gradient distances. The FAA does not agree. The combination of discrete gust analysis under § 25.341 and continuous turbulence analysis under § 25.305 is less complex than the method described by these commenters and provides sufficient substantiation of strength. The proposal is adopted without substantive changes.

Proposal 8–29. Many negative comments were received on the proposal to revise § 25.307(a) to require ultimate load tests for each normal and fail-safe critical load condition. Three commenters indicate that the proposed regulation would add to the cost and time required for certification although present airplane safety records do not support the need for a change. One commenter points out that the design philosophy used for commercial transports, due to the dominant influence of the economic requirement for long life without structural fatigue problems, often produces reserve margins of safety. Another commenter proposes that ultimate load tests be limited to structures such as composites, which substantially differ from conventional structure. The FAA agrees that to conduct ultimate load tests for all critical load conditions would greatly increase the amount of testing required, which is not warranted by the safety record since there have been no service features which indicate that present methods of substantiation are inadequate. In many cases failures in service result from conditions such as fatigue or corrosion which are not covered by ultimate load tests. The proposal to require ultimate testing of all structural components therefore is deleted. In some cases, however, analysis must be supplemented by limit and/or ultimate load tests. The amendment, as adopted, is revised accordingly.

Proposal 8–30. Several negative comments were received on §§ 25.365(e) and (f), requiring airplane designers to consider pressure vessel decompression resulting from the loss of any nonplug door, detonation of a bomb within the cabin at all probable locations, and engine disintegration. Several commenters oppose designing for the loss of a nonplug door, stating that there is no reason why nonplug doors cannot be designed to be as safe as plug doors. These commenters suggest that the door design criteria be upgraded to improve door integrity. The FAA agrees that door integrity should be improved to the extent that design for their loss is not justified. Therefore § 25.783 is revised in response to Proposal 8–35 to require this improved level and § 25.365(e) (1) is withdrawn.

Many commenters object to designing for all possible bomb detonations and probable bomb locations. A commenter points out that airworthiness requirements in the past have attempted to safeguard aircraft against structural and mechanical failure, human error, natural hazards, etc. They note that no one has attempted to incorporate into airworthiness requirements the consequences of homicidal or suicidal tendencies. Another commenter states that the aircraft industry has to accept responsibility for compensating the public for loss or injuries resulting from defects in its products, and the inclusion of a bomb damage requirement in Part 25 could significantly extend the grounds of possible product liability actions, particularly with the imprecise requirements of § 25.365(e). Many commenters state that the wording of § 25.365(e) (3) is so vague as to make its implementation impossible. The FAA notes that, ultimately, minimizing the loss of airplanes as a result of bomb explosions is a ground security problem.

A commenter suggests an alternative to § 25.365(e) (3) which would establish a relationship between the design maximum opening and the cross-sectional area of the pressurized shell. The FAA agrees that the proposed relationship provides an acceptable method for determining hole size. The FAA has determined that the maximum hole size required should be 20 square feet, a value contained in Airworthiness Directive 75–15–05 (August 11, 1975) pertaining to openings in wide-body transports. Section 25.365(e) (3) is revised to allow the maximum opening to vary as a function of the cross-sectional area of the pressurized shell to account for the differences in size between narrow and wide-body transports and is redesignated and adopted as § 25.365(e) (2).

The FAA finds that the maximum opening specified in adopted § 25.365(e) (2) will exceed the opening that would result from causes other than bomb explosions or engine disintegration, and that a probability safety analysis to determine hole size in passenger or cargo areas resulting from other causes is not needed. Thus, proposed § 25.365(f) is withdrawn.

In light of the comments received on proposed § 25.365(e) (4), and after further consideration, the FAA concludes that openings caused by airplane or equipment failure can occur in any compartment, and that partitions, bulkheads, and floors should be designed for openings from these causes. Thus, proposed § 25.365(e) (4) is revised accordingly, redesignated, and adopted as § 25.365(e) (3).

No adverse comments were received on proposed § 25.365(e) (2) to require design to withstand penetration of the cabin by a portion of an engine following engine disintegration and the proposal is redesignated § 25.365(e) (1) and adopted without substantive change.

Amendment to § 25.571(a) (3). Because of the change to § 25.1529 adopted in this amendment, the reference to the "maintenance manual" in § 25.571(a) (3) is no longer appropriate. For consistency, § 25.571(a) (3) references the Airworthiness Limitations section of the Instructions for Continued Airworthiness.

Proposal 8–31. Numerous unfavorable comments were received on the proposal to add a new § 25.633 requiring that essential systems be designed to minimize damage caused by detonation of a bomb in the airplane. Most commenters contend that there is no means to protect essential systems from all possible bomb detonations and that bomb size and location cannot be rationally defined. Several commenters indicate that the separation of essential systems on modern airplanes presently provides a measure of protection and that the proposed requirements of § 25.633 are beyond the state of the art.

The FAA agrees that a rational means of determining and defining all possible bomb size/location combinations which would damage essential systems does not exist. Therefore, the proposal is withdrawn.

Proposal 8–32. Several commenters object to the proposed horizontal stabilizer "trim-in-motion" aural warning requirement of § 25.677(e) on the grounds that the aural environment in today's cockpits is already cluttered and that finding new and distinctive aural warnings is becoming difficult. They further suggest that small increments of trim change should not cause aural warning, and that warnings should be given only when a

safety-of-flight hazard exists. One commenter suggests that there is no need for separate aural warning on aircraft having direct trim control wheels in the cockpit.

The FAA agrees with the comments and upon further review concludes that the proposal is premature and unworkable. Accordingly, it is withdrawn for further study.

Proposal 8-33. Several adverse and supporting comments were received on the proposal to add a new § 25.685(e) requiring arrangement of control systems to provide an airplane with the capability of continued safe flight and landing in the event of an inflight localized structural failure. Several commenters agree with the intent of the proposal and propose minor changes. One commenter agrees with the intent of the proposal, but believes that only failures which have not been shown to be extremely improbable need be considered. Commenters state that the intent of the proposed rule change is already encompassed by § 25.365(e) which would require that floor failure resulting from rapid decompression be shown to be extremely improbable.

A commenter further states that present § 25.671(c) requires control systems to be designed to be tolerant of failures, and that control system damage is more likely from other sources. The commenter claims that service experience and rational analysis show that the floor structure provides the best available protection for the control system from damage from these other sources.

After further study the FAA agrees with the commenters that the primary objectives of this proposal are adequately covered by several existing sections of FAR 25. For example: § 25.365(e) requires that the floor be designed for pressure vessel opening which is a function of the cross-sectional area of the fuselage; § 25.571 requires all structure to be damage tolerant where practical; § 25.671 requires that control systems be tolerant of failures, including exterior damage; § 25.629 requires freedom from flutter under failure conditions; § 25.631 requires protection of controls in the empennage structure from bird strikes; and § 25.901(d) requires design precautions be taken to minimize the hazards to the airplane, including control systems, in the event of an engine rotor failure. The proposal therefore is withdrawn.

Proposal 8-34. For an explanation of the withdrawal of the proposals concerning automatic systems that affect airplane performance, one of which is the proposal to add a new § 25.705, see Proposal 8-26.

Proposal 8-35 and 2-59. Several commenters object to the requirement in § 25.783(e) that provisions for the inspection of door locking mechanisms must be discernable under all possible lighting conditions. The commenters state that allowance should be made for use of supplemental lighting such as a flashlight to aid in the inspection. The FAA agrees and the section is revised accordingly.

A commenter states that direct visual inspection is only needed for external doors for which the initial opening movement is not inward and which are pressurized or for which an inadvertent opening could prevent continued safe flight and landing. Although these comments have merit, they go beyond the scope of Proposal 8-35 and interested parties have not had an opportunity to comment on these changes. No change to the section is being made based on these comments. Several commenters object to the redundancy of a dual warning system requirement and state that in lieu of redundancy, a reliability level should be specified. Further comments state that all external doors do not require this level of reliability. The FAA agrees that this reliability level could be specified and should apply only to external doors for which initial movement is not inward, and the section is changed accordingly. The present language defining where door warning systems are required is retained, as no change in present practice is intended.

A commenter suggests that § 25.783(e) should specify several good design practices. These design practices are desirable but are not essential, since the necessary level of safety can be obtained by alternate means under § 25.783.

Several commenters object to new § 25.783(f), suggesting that it apply only to nonplug type doors and doors whose loss would present a probable hazard. The FAA agrees that provisions to prevent unsafe pressurization can be limited to doors whose loss would

present a probable hazard. However, the FAA does not agree that it should be limited to nonplug type doors because a plug door is defined as one whose initial opening is inward and this feature does not necessarily provide complete assurance that an unsafe pressurization will not occur with subsequent opening of the door in flight. The clarifying phrase "to an unsafe level" has been added to § 25.783(f). The intent is to prevent pressurization to a level which would be hazardous if an unlocked external door inadvertently opened.

Several commenters object to proposed new § 25.783(g) (Proposal 8–35), stating that it would unnecessarily preclude the use of nonplug type doors above 45,000 ft. The FAA agrees that nonplug type doors can safely be used at altitudes above 45,000 ft., since adequate warning systems and door integrity are provided by § 25.783(e). Proposed new § 25.783(g) is withdrawn.

A commenter proposes that for the door whose opening would be a hazard, the door and immediate surrounding fuselage, door mechanisms, and warning system be designed for any combination of failures (including improper operation) not shown to be extremely improbable. The FAA agrees. In place of the proposals in 8–30, with regard to §§ 25.365(e) (1), (3), and (4), a rule is included to require determination by safety analysis that inadvertent opening of doors which could prevent continued safe flight and landing is extremely improbable.

Two commenters state that the criteria for passenger egress in the revision to the second sentence of § 25.783(g) (Proposal 2–59 of Notice 75–10) should be evacuation time, and not the rate of passenger egress through a given exit. The FAA agrees. Revision of the second sentence of § 25.783(g) is redesignated as § 25.783(i) and the reference to § 25.561(a) (3) in the proposal is corrected to reference § 25.561(b) (3).

Numerous negative comments concern proposed new § 25.783(j), which requires that lavatory doors open into the cabin to preclude anyone from being trapped in the lavatory. The commenters state that this requirement is overly restrictive on design and that an outward opening door could have an adverse effect on aisle width and emergency evacuation capabilities if such a door jammed open. The FAA agrees that inward opening doors can be designed to prevent anyone being trapped in a lavatory in cases of incapacitation or for other reasons. Thus, new § 25.783(j) is revised to delete the requirement that lavatory doors open into the cabin.

Proposals 8–36, 2–60, and 8–37. Final action on Proposals 8–36, 2–60, and 8–37 was taken in Airworthiness Review Program, Amendment No. 8: Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Proposal 8–38. One commenter objects to adding a new § 25.792 to require a sign indicating whether lavatories are occupied, asserting that it would be inappropriate for general aircraft certificated under Part 25. Two commenters doubt that the proposed rule would achieve the objective of preventing aisle congestion near lavatories. They point out that many existing aircraft have similar signs which have not prevented people from "standing in line" for lavatories. Also, passengers can cause congestion in aisles for other reasons. One of the commenters states that lighted signs in a darkened cabin; i.e., during movies or rest periods, would annoy passengers, and that the rule might foster a proliferation of signs throughout the cabin. Finally, one commenter is concerned that any increase in the number of lighted signs might distract the passengers' attention from more essential notices.

Based on the comments and upon further review, the FAA finds that the proposed requirement would not achieve the objective sought. Accordingly, the proposal is withdrawn.

Proposal 8–39. Final action on Proposal 8–39 was taken in Airworthiness Review Program Amendment No. 8: Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Proposal 8–40. Final action on Proposal 8–40 was taken in Operations Review Program Amendment No. 8 (45 FR 41586, June 19, 1980).

Proposal 8-41. A commenter suggests that new § 25.851(a) (5), which replaces current § 25.853(f), be expanded to prescribe four fire extinguishers for a passenger capacity of 100 or more, and to require at least one CO_2, dry chemical, or all purpose fire extinguisher near lavatory and galley areas. These suggested changes are beyond the scope of the notice. However, changes in these requirements are appropriate and the FAA is conducting a research program to establish comprehensive standards and guidance information pertaining to the selection of portable fire extinguishers, taking into consideration types and quantities of extinguisher agents, extinguisher performance, and other factors. Regulatory changes based on the findings of this research program will be proposed in the next airworthiness standards review.

Sections 25.851(a) (5) and (a) (6), which consolidate hand fire extinguisher requirements, are adopted without substantive change.

Proposals 8-42, 2-18, 2-65, 2-114, and 2-160. Final action on Proposals 8-42, 2-18, 2-65, 2-114, and 2-160 was taken in Airworthiness Review Program, Amendment No. 8: Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Proposal 8-43. Final action on Proposal 8-43 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 8-44. For a discussion of proposed § 25.905(c), see the discussion under Proposal 8-103. The proposal to add a new § 25.905(c) is adopted without substantive change.

Proposals 8-45 and 8-96. The proposed amendments to §§ 25.939 and 33.65 are being deferred for consideration in a forthcoming notice of proposed rule making of the Aircraft Engine Regulatory Review Program.

Proposals 8-46, 3-35, and 8-47. Final action on Proposals 8-46, 3-35, and 8-47 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; Oct. 30, 1978).

Proposal 8-48. For an explanation of the withdrawal of the proposals concerning automatic takeoff thrust control systems, one of which is the proposal to add a new § 25.1143(f), see Proposal 8-26.

Proposals 8-49 and 3-41. Final action on Proposals 8-49 and 3-41 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; Oct. 30, 1978).

Proposal 8-50. For an explanation of withdrawal of the proposals concerning automatic takeoff thrust control systems, one of which is the addition of a new § 25.1305(c) (9), see Proposal 8-26.

One commenter objects to revising § 25.1305(d) (1), stating that significant aerodynamic forces acting on the powerplant nacelle make the direct measurement of thrust impractical. The FAA agrees that such forces may be significant. This commenter further objects to the revision, stating that it is beyond the state of the art to prohibit a parameter from being used if the accuracy of the indication will be adversely affected by any engine malfunction or damage. The FAA agrees that precise values of thrust provided by a malfunctioning, damaged, or deteriorated engine are unnecessary, provided that any changes in thrust due to engine malfunction, damage, or deterioration are indicated to the pilot. The paragraph is revised to require that the indication must be based on the direct measurement of thrust or of parameters that are directly related to thrust.

Although concurring with § 25.1305(d) (1), one commenter states that he would prefer to retain the existing requirements and delete the words ",or to indicate a gas stream pressure that can be related to thrust,". The FAA does not agree. The change suggested by this commenter would eliminate the requirement for thrust information and would retain the requirement for change-of-thrust information only. It also would provide a lower level of safety than the adopted paragraph.

This commenter also states that § 25.1305(d) (1) should be complementary to a similar requirement in Part 33 of this chapter. The FAA does not agree. In current practice, the airframe manufacturer determines how performance should be met. The choice of a

means to indicate thrust is negotiated between the airplane manufacturer and the engine manufacturer. The factors which influence the final choice are substantial and may vary among airplane designs. These factors may not be known to the engine manufacturer at the time of engine type certification. Another commenter states that the need for an actual value of thrust is not obvious, whereas indication of a loss of thrust would satisfy the original proposal. The FAA agrees that the actual value of thrust is of little value to the pilot. Section 25.1305(d) (1) is revised to specify that the indicator indicate thrust, or a parameter related to thrust, to the pilot.

Proposal 8–51. No unfavorable comments were received on the proposal to change the reference in § 25.1307(h) for fire extinguishers in connection with Proposal 8–41. Accordingly, the proposal is adopted without substantive change.

Proposal 8–52. Final action on Proposal 8–52 was taken in Airworthiness Review Program, Amendment No. 8: Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Proposal 8–53. Several commenters point out a number of service deficiencies with proposed § 25.1421 which defines the requirements for cargo compartment fire detection systems. They contend that the requirement for the detection system to actuate a warning within one minute of the start of a fire is too restrictive. One commenter cites the results of FAA tests which show average fire detection times to be from 1.75 to 5 minutes. The commenters also suggest that the tests necessary to show compliance with the warning requirements are not clearly defined. Finally, one commenter points out that fires in baggage containers and other enclosed containers can burn for a considerable time before detection is likely by fire detectors in the cargo compartment.

The FAA does not concur that the one-minute requirement is too restrictive. A survey of fire detection technology has indicated that the state of the art permits detection of a fire in less than one minute after inception. In addition, current standards do not define the test procedures necessary to show compliance with warning requirements. The new one-minute requirement is intended to improve the standards in this regard.

The proposal is adopted without substantive change.

NOTE: This proposal has been carried erroneously under § 25.1421 which pertains to megaphones. It will be included in the amendment as a new § 25.858.

Proposal 8–54. Comments received from several commenters reflected confusion over the intent of proposed § 25.1439(c). It was noted that much of what was intended by proposed § 25.1439(c) is included in existing § 25.1439(a) as amended by Amendment 25–38 (41 FR 55454; 12/20/76), provided that the portable oxygen requirements of § 25.1447(c) (4) are retained. Amendment 25–38 emanated from Airworthiness Review Program Notice No. 2 (40 FR 10813; 3/7/75), and was adopted (41 FR 55468; 12/20/76) after publication of Airworthiness Review Program Notice No. 8 (40 FR 29420; 7/11/75) which contained proposals 8–54 and 8–55. The FAA agrees that the existing regulations require much of what was intended by proposal 8–54, provided that proposal 8–55 is withdrawn. The FAA further agrees that additional clarifications are needed before further amendments are made to § 25.1439. Therefore the FAA withdraws both proposals 8–54 and 8–55. The subject of protective breathing equipment will be addressed in a forthcoming notice of proposed rule making.

Proposal 8–55. The proposal to delete § 25.1447(c) (4) is withdrawn for the reasons stated for withdrawal of Proposal 8–54.

Proposal 8–56. For comments related to the proposal to revise § 25.1521(a), and for the withdrawal of that proposal, see Proposal 8–94.

Proposal 8–57. Final action on Proposal 8–57 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 8–58. For comments related to the proposal to amend § 25.1529, see Proposal 8–21.

Proposal 8–59. A commenter objects to the proposed new § 25.1557(e), calling for a placard on each flight attendant seat to indicate that it may be occupied by a flight

attendant, asserting that such placarding is redundant and that a proliferation of placards in the aircraft will only serve to confuse the passengers and make all placards less effective. The commenter also states that the proposal would prohibit non-flight attendant airline personnel who are cognizant of emergency procedures from occupying flight attendant seats when the aircraft is full. The FAA concludes that a new aircraft certification rule is unnecessary to achieve this result and the proposal is withdrawn.

Proposals 8–60 and 8–61. Final action on Proposals 8–60 and 8–61 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 7–55. A commenter recommends that discrete gusts with varying gradient distances be added as a supplement to Appendix G to Part 25. The FAA disagrees because past experience with the use of discrete gusts with varying gust gradient distances has indicated that knowledge with regard to how gust intensity varies with gust gradient distance is not currently available to the designer. The research and development work accomplished in the area of dynamic response to continuous turbulence has indicated that the continuous turbulence criteria of Appendix G to Part 25 is the most rational approach currently available which gives consistent strength levels for airplanes of different characteristics and missions.

A commenter recommends that paragraph (a) of Appendix G be revised to delete the requirement for considering combined stresses based on both vertical and lateral components of turbulence. The commenter states that the current practice of combining root-mean-square stresses (shear, moment, and torsion) resulting from gust calculations involving only purely vertical or lateral components of turbulence is a realistic, practical method for combining stress. The commenter contends that the methods for realistically combining statistical load quantities involving both vertical and lateral components of turbulence have not been satisfactorily developed in the current state of the art. After further review the FAA agrees. Paragraph (a) of Appendix G is revised to delete the requirement for considering the combined stresses resulting from the vertical and lateral components of turbulence.

A commenter recommends that paragraph (b) (3) (i) of Appendix G be revised to require a gust intensity of $U\sigma = 75$ fps gust velocity in the interval 0 to 20,000 ft. altitude with a linear decrease to 30 fps at 80,000 ft. altitude. This recommendation would obviate the need to do mission analysis to justify lower levels of loads than those required to meet the design envelope gust intensity factor of 85 fps for new airplanes whose characteristics are similar to previous designs which have been shown to be adequate for the lower level of gust intensity being proposed. There is no technical need for new aircraft which are similar to existing aircraft with regard to response characteristics and basic mission profiles to make extensive mission analysis computations in order to establish their adequacy with regard to loads resulting from encounters with continuous turbulence if they are designed for the gust intensity shown to be adequate for the existing design. Therefore, it is acceptable to use a gust intensity value of 75 fps from 0 to 20,000 ft. altitude, and a linear reduction from 75 fps at 20,000 ft. to 30 fps at 80,000 ft., provided the new design is comparable to a similar design with extensive satisfactory service experience. These criteria, which have been under discussion between FAA and industry for over 10 years, are proposed as new rules rather than acceptable means of complying with existing rules. Paragraph (b) (3) (i) is revised accordingly. The commenter also recommends that paragraph (d) (1) be revised to require a gust intensity of $U\sigma = 60$ fps on the interval 0 to 20,000 ft. altitude and be linearly decreased to 23 fps at 80,000 ft. altitude. The FAA disagrees. The gust intensities in paragraph (d) (1) are based on the distribution of gust intensity with altitude which were developed in the basic research for the development of continuous turbulence criteria and are, therefore, considered reasonable as a lower design envelope limit for mission analysis. A cost analysis was provided by the commenter to justify the lower gust intensities, but the FAA finds that this cost analysis was based on "design envelope analysis" alone. Paragraph (c), which is an alternative to paragraph (b), provides for a "mission analysis". Actual experience has

shown that "mission analysis," which considers airplane operational characteristics, has been used in the past in lieu of the 85 fps intensities to prevent weight and cost penalties. Paragraphs (c) and (d) of Appendix G are adopted without substantive change.

A commenter recommends that paragraph (d) of Appendix G be revised to delete the reference to "fail-safe loads" since such loads are not provided in Appendix G. The FAA agrees. Paragraph (d) of Appendix G is revised accordingly.

A commenter recommends that proposed paragraph (e) of Appendix G be deleted since acceleration levels measured at the pilot station on current conventional aircraft can be established by flight demonstration much more easily and with less cost than by use of an expensive analysis considering response to continuous turbulence. Upon further review, the FAA has determined that it lacks sufficient information to specify the right combination of analysis and flight test to determine the acceleration levels at the pilot's station during continuous turbulence. Accordingly, proposed paragraph (e) of Appendix G is withdrawn. The current requirements related to operation in turbulence are adequate to determine the response at the pilot's station during continuous turbulence.

Proposal 8–62. For comments related to the proposal to add a new Appendix G to Part 25, see Proposal 8–25. Appendix G (redesignated Appendix H) to Part 25 is adopted with the changes discussed in Proposal 8–25.

Proposal 8–63. Final action on Proposal 8–63 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Amendment to § 27.571. Because of the change to § 25.1529 adopted in this amendment, the reference to § 27.1529(a) (2) in §§ 27.571(b), (c), (d) (1), (d) (3), and (e) is no longer appropriate. The reference is changed to "§ A27.4 of Appendix A". This discrepancy was overlooked in Notice 75–31 (40 FR 29410; July 11, 1975). Since this amendment is clarifying in nature and does not impose a burden on the public, notice and public procedure are unnecessary and good cause exists for adopting this amendment.

Proposal 8–64. For comments related to the proposal to amend § 27.1529, see Proposal 8–21.

Proposals 8–65 and 8–66. Final action on Proposals 8–65 and 8–66 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 8–67. For comments related to the proposal to add a new Appendix A to Part 27, see Proposal 8–25. Additional comments on this proposal, and on the proposal to add a new Appendix A to Part 29, are discussed here.

A commenter suggests that the wording of Appendix A be adjusted to take into account the differences between airplanes and rotorcraft. The FAA agrees. The appendix, as proposed, is generally equally applicable to airplanes and rotorcraft. However, several minor changes have been made to the appendix to provide for rotorcraft differences, primarily to cover rotors and differing fatigue standards.

A commenter objects to Appendix A, contending that: (1) The standards in current §§ 27.1529 and 29.1529 have been adequate in service, and (2) the proposal is excessive in scope and would create an undue burden. The FAA does not agree, having found that recommended maintenance procedures made available to operators/owners in the past were frequently inadequate in scope and content, providing no sound basis for maintaining the airworthiness of the rotorcraft. Appendix A, with the revisions and deletions discussed above and under Proposal 8–25, would not create an undue burden on the type certificate applicant.

One commenter expresses concern that certain inspection provisions in current § 91.217 might be applied to rotorcraft. The appendix contains no such requirement. Current § 91.217 applies only to certain airplanes.

Amendment to § 29.571. Because of the change to § 29.1529 adopted in this amendment, the reference to "§ 29.1529(a) (2)" in §§ 29.571(b), (c), (d) (1), (d) (3), and (e) is no longer appropriate. For consistency, the reference is changed to "§ A29.4 of Appendix A required by § 29.1529". This change was overlooked in Notice 75–31 (40 FR 29410; July

11, 1975). Since this amendment is clarifying in nature and does not impose a burden on the public, notice and public procedure are unnecessary and good cause exists for adopting this amendment.

Proposal 2-154. For a discussion directly related to proposed new § 29.783(g), see the discussion under Proposal 8-35 for § 25.783(g) (Proposal 2-59 of Notice 75-10). Section 29.783(g) is adopted without substantive change.

Proposals 8-68 through 8-76 and 2-164. Final action on Proposals 8-68, 8-69, 8-70, 8-71, 8-72, 8-73, 8-74, 8-75, 8-76, and 2-164 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 8-77. For comments related to the proposal to amend § 29.1529, see Proposal 8-21.

Proposals 8-78 and 8-79. Final action on Proposals 8-78 and 8-79 was taken in Airworthiness Review Program, Amendment No. 7: Airframe Amendments (43 FR 50578; October 30, 1978).

Proposal 8-80. For comments related to the proposal to add a new Appendix A to Part 29, see Proposals 8-25 and 8-67.

Proposal 8-81. No unfavorable comments were received on adding a new § 31.12 providing for standardized application of the airworthiness requirements for balloons. Accordingly § 31.12 is adopted without substantive change.

Proposal 8-82. No unfavorable comments were received on adding a new § 31.16 requiring that balloon empty weight be determined. Accordingly, § 31.16 is adopted without substantive change.

Proposal 8-83. No unfavorable comments were received on the intent of new § 31.17 which specifies performance in terms of an initial minimum rate of climb. However, a commenter raises the question whether compliance with proposed § 31.17(a) could be shown by testing at several altitudes and ambient temperatures and then extrapolating, by appropriate analysis, to the other values in the range for which approval is sought. The FAA considers that such extrapolation by analysis is an acceptable means of complying with proposed § 31.17(a), because the climb performance of balloons is based on fundamental principles and, therefore, can be predicted with sufficient accuracy from established test points.

The FAA notes that the 300 fpm climb rate requirement in § 31.17(a) was intended as a minimum standard. To make this clear, § 31.17 as adopted is revised by inserting the words "at least" before the number "300" in the first sentence of § 31.17(a).

Proposal 8-84. A commenter, referring to new § 31.19(a) governing critical uncontrolled descent, suggests that it would be difficult and time-consuming to determine which tear is the most critical single tear in the balloon envelope between tear stoppers. The FAA does not agree. An analysis, or a combination of test and analysis, would be an acceptable means of determining the most critical single tear. It would not be necessary to test each kind of tear. No other unfavorable comments were received on the proposal to add a new § 31.19. Accordingly, § 31.19 is adopted without substantive change.

Proposal 8-85. No unfavorable comments were received on the proposal to amend § 31.27(c) to be consistent with new § 31.19, Performance: Uncontrolled descent. Accordingly, the proposal is adopted without substantive change.

Proposal 8-86. No unfavorable comments were received on the proposal to amend § 31.65 updating the position light standards and expressing them in language consistent with related standards in other airworthiness parts. However, the FAA finds that the use of a cross reference to § 23.1397 as proposed in § 31.65(e) may be inconvenient for those governed by Part 31. Accordingly, § 31.65, as adopted, sets forth the chromaticity coordinates for aviation red and aviation white as currently prescribed in § 23.1397.

Proposal 8-87. No unfavorable comments were received on the proposal to amend § 31.71. However, after further consideration, the FAA concludes that proposed § 31.71(a) (2) is unnecessarily restrictive in that it would, in all cases, require marking the

equipment as to its identification, function, *and* operating limitations. Marking of the equipment as to its identification, function, *or* operating limitations, or any applicable combination of those factors is sufficient. This is also the language used in corresponding sections of other aircraft airworthiness regulations. Section 31.71, as adopted, is revised accordingly.

Proposal 8–88. No unfavorable comments were received on the proposal to amend § 31.81 to detail operating limitations and information. The FAA notes, however, that proposed § 31.81(b) is not clear as to which "operating limitations and other information necessary for safe operation" must be furnished. The FAA's intent, as stated in the explanation, is to require that the information established under § 31.81(a) be furnished. Section 31.81(b) is revised accordingly. Section 31.81(a) is adopted without substantive change.

Proposal 8–89. A commenter is concerned that proposed § 31.82 might require balloon manufacturers to prepare two overlapping maintenance documents—the maintenance manual currently supplied to operators/owners, and the proposed Instructions for Continued Airworthiness. The FAA notes that under §§ 31.82 and 21.50(b), balloon manufacturers would be required to prepare and furnish only the Instructions for Continued Airworthiness.

The FAA notes further (as discussed under Proposal 8–21) that the Instructions for Continued Airworthiness need not be finalized until delivery of the first balloon, while § 31.82, as proposed, could be interpreted to require that they be finalized before type certification. This point is clarified in § 31.82, as adopted, consistent with the corresponding requirement in Parts 23, 25, 27, and 29.

Proposal 8–90. No unfavorable comments were received on the proposal to amend § 31.85(b) (1). However, a commenter questions whether percentage figures on the required fuel quantity gauge would be acceptable. The FAA has determined that, in the particular case of balloons (for which the fuel quantity information is to an extent less important to safety than for other classes of aircraft), calibration of the fuel quantity gauge in percent of fuel cell capacity is an acceptable means of complying with the last sentence of § 31.85(b) (1). Section 31.85(b) (1), as adopted, is revised to make this clear.

Proposal 8–91. No adverse comments were received on the proposal to add a new Appendix A to Part 31. However, comments received on the proposals to add a similar appendix to Parts 23, 25, 27, and 29 (Proposal 8–25), were equally valid with respect to this proposal. Accordingly, Appendix A to Part 31, as adopted, is revised in substance as applicable.

Regarding the proposals to require generalized repair data in the Instructions for Continued Airworthiness, it is more appropriate, as well as necessary and practicable, to include specific instructions for repair of the key elements of a balloon—the balloon envelope and its basket or trapeze. This information is incorporated in paragraph A31.3(i) as revised.

Proposal 8–92. A commenter objects to § 33.4 insofar as it would require completion of the Instructions for Continued Airworthiness before the type certificate is issued, contending that a significant portion of the data and other material called for is typically not compiled until 6 months or longer after type certification. The commenter suggests that manufacturers be allowed to prepare and make available the Instructions for Continued Airworthiness before the first aircraft equipped with the subject engine is put into service, which, it claims, is the earliest such instructions would be needed. Requiring the engine manufacturer to complete the Instructions for Continued Airworthiness before the type certificate is issued would constitute an unnecessary burden. However, the FAA considers that they must be made available, and furnished, upon delivery of the first engine on an aircraft or issuance of a standard certificate of airworthiness for the aircraft, whichever occurs later. This would be consistent with corresponding requirements proposed for other products. See Proposals 8–5 and 8–21. Section 33.4 is revised and adopted accordingly.

Proposal 8-93. A commenter observes that § 33.5 requires that the instruction manual for installing and operating the engine be "approved," whereas proposed § 33.4 requires that the Instructions for Continued Airworthiness be "acceptable to the Administrator," and recommends that the latter term be used for consistency. The FAA notes that the term "acceptable to the Administrator" is widely used in Part 43 in connection with maintenance requirements, whereas the term "approved" is more frequently used in FAR Parts containing installation and operating requirements. Considering the FAR as a whole, the FAA does not agree that such consistency is essential. Accordingly, § 33.5 is adopted as proposed.

Proposal 8-94. Several commenters object to proposed §§ 33.6(e) and (f), and to proposed §§ 23.1521(a) and 25.1521(a) (Proposals 8-20 and 8-56, respectively) on the grounds that the use of rated takeoff power or thrust for 10 minutes with one engine inoperative should not be limited to "the extent that the utilization is necessary for the airplane to avoid, without necessitating turning maneuvers, obstacles beneath the flight path intended for the airplane prior to the loss of the engine." In light of these comments and after further review, the FAA concludes that these proposals are premature and they are withdrawn.

In addition, the proposed transfer of the definitions for rated power and thrust from § 1.1 to proposed new § 33.6, Proposal 8-1, is withdrawn since the transfer may cause confusion in the administration of the aircraft certification requirements. Accordingly, Proposals 8-1, 8-20, 8-56, and 8-94 are withdrawn.

Proposal 8-95. For discussion of proposed § 33.19(b) see the discussion under Proposal 8-103. Revised § 33.19 is adopted without substantive change.

Amendment to §§ 33.55(c), 33.57(b), 33.93(b), and 33.99(b). Because of the deletion of §§ 33.5(c), (d), and (e), and the addition of a new § 33.4, the reference to "§ 33.5" in §§ 33.55(c), 33.57(b), 33.93(b), and 33.99(b) is no longer appropriate. For consistency, the reference is "§ 33.4." This change was inadvertently overlooked and was not proposed in Notice 75-31 (40 FR 29410; July 11, 1975). This editorial change corrects that discrepancy. Since this amendment is clarifying in nature and does not impose a burden on the public, notice and public procedure are unnecessary and good cause exists for adopting this amendment.

Proposal 8-97. A commenter recommends that § A33.3(a)(6) of Appendix A to Part 33 be revised by adding the words "requiring periodic attention" so as to make it clear that scheduling information is required solely for parts that require such attention. The language in this section is adequate. For parts not needing periodic attention, the applicant has only to state that parts not scheduled need not be serviced.

A commenter infers incorrectly that proposed §§ 43.16 and 91.163(c) apply only to rotorcraft. These regulations with the revision proposed also affect other classes of aircraft, as well as engines and propellers.

Some comments received on the proposed appendices for Parts 23, 25, 27, and 29 (Proposal 8-25) were equally valid with respect to proposed Appendix A to both Parts 33 and 35. Accordingly, the appendices to Parts 33 and 35 are revised in substance as applicable.

Proposal 8-98. For a discussion related to proposed § 35.3 see Proposal 8-93. A commenter observes that § 35.3 requires that the instruction manual for installing and operating the propeller be "approved," whereas § 35.4 requires that the Instructions for Continued Airworthiness be "acceptable to the Administrator," and recommends that the latter term be used for consistency. The FAA notes that the term "acceptable to the Administrator" is widely used in Part 43 in connection with maintenance requirements, while the term "approved" is more frequently used in FAR parts containing installation and operating requirements. Considering the FAR as a whole, the FAA does not agree that consistency is required in this instance. Accordingly, § 35.3 is adopted as proposed.

Proposal 8-99. In response to the concern of a commenter representing a number of Part 121 operators, the FAA notes that there is no requirement that any operator/owner use the Instructions for Continued Airworthiness referred to in proposed § 35.4. The new §§ 43.13(a), 43.16, and 91.163(c) allow the use of other methods. In particular, the use of maintenance manuals and continuous airworthiness maintenance programs developed under Parts 121, 123, 127, and 135, or an inspection program approved under § 91.217(e) would be acceptable alternatives to the Airworthiness Limitations section. This commenter suggests that language be added to proposed § 35.4 to make it clear that such alternatives may be used. The FAA agrees. The language in §§ 43.16 and 91.163(c) is revised accordingly.

Consistent with the discussion on proposed § 33.4 dealing with engines (see Proposal 8-92), the FAA finds that requiring the propeller manufacturer to complete the Instructions for Continued Airworthiness before the type certificate is issued would constitute an unnecessary burden. Accordingly, § 35.4 as adopted, requires that those instructions be made available and furnished upon delivery of the first aircraft with the propeller installed, or upon issuance of a standard certificate of airworthiness for an aircraft with the propeller installed, whichever occurs later.

Proposal 8-100. No unfavorable comments were received on the proposal to amend § 35.5 to more clearly indicate the basis for operating limitations and where they are listed. Accordingly, § 35.5 is adopted without substantive change.

Proposal 8-101. No unfavorable comments were received on the proposal to amend § 35.23 to provide an extreme low pitch indication. Accordingly, § 35.23 is adopted without substantive change.

Proposal 8-102. A commenter does not concur with the proposal to revise § 35.37 to require evaluation of metallic hubs and blades, stating that the words "must", "all", and "reasonably foreseeable" in the second sentence imply responsibility beyond current knowledge and the state of the art. The FAA does not agree. These terms are used in the current rule and the current state of the art defines the limits of the provision.

The same commenter recommends that § 35.37 be revised to apply to consideration of "normal and reasonably foreseeable load patterns," to account for the fact that only normal operations will or should be considered. The FAA does not agree. Load patterns which are reasonably foreseeable are critical and should be investigated even if they are not normal.

The same commenter also indicates that the third sentence should be revised to eliminate the term "reduction factors," since reduction factors are identified with only one particular method of presentation. The FAA agrees and the section is revised accordingly. This commenter finally states that the explanation implies that manufacturers have not taken permissible damage and material variation into account. This implication is not intended. It is the FAA's view that the fatigue evaluation should consider the occurrence of typical service damage and variation in material properties and the rule would provide for such an evaluation.

Another commenter suggests that the section be revised by adding certain technical requirements that are related to infinite component life. It is not necessary to specify requirements concerning infinite component life, since they are considered a normal part of propeller fatigue testing.

Section 35.37 is adopted as revised.

Proposal 8-103. A commenter objects to the proposal to add a new § 35.42 to define durability requirements for propeller blade pitch control system components, stating that the term "bench tests" in §§ 35.42(a) and (b) is too descriptive and restrictive. The FAA agrees that a reference to "bench tests" may be too restrictive. Other test methods may be equally acceptable in providing the necessary data. Accordingly, §§ 35.42(a) and (b) are revised to eliminate the specific reference to "bench."

The commenter also suggests that the words "in frequency and amplitude" be eliminated from § 35.42(a) since the words "cyclic testing" are fully descriptive. The FAA believes that these words are needed to prescribe key elements in the required test.

The commenter further suggests that the proposed testing to the equivalent of 1,000 hours of propeller operation is too restrictive in the case of a propeller with an overhaul period of less than 1,000 hours. The FAA considers the specific testing to be the minimum necessary to provide an acceptable safety level in service. The rule does not, however, prevent the selection of overhaul intervals of less than 1,000 hours.

Finally, the commenter suggests that the rule should permit an alternate of acceptance based upon service experience. The FAA recognizes that service experience can provide a statistical basis for determining component reliability. Its applicability, however, may vary according to such considerations as type of operation, the nature of the article under consideration, the degree of similarity between the reference article and the certification article, and the completeness of service records. Since it is dependent on such a variety of factors, the FAA does not agree that a specific alternative based on service experience should be included.

The proposal to add a new § 35.42, therefore, is adopted with the change discussed below. No adverse comments were received on the related proposed revisions to §§ 23.905, 25.905, and 33.19 to add the reference to new § 35.42, and the revisions are adopted.

Proposal 8-104. For comments related to the proposal to add a new Appendix A to Part 35, see Proposals 8-25 and 8-97.

A commenter objects to proposed § A35.1(c) of the appendix because the propeller owner (aircraft operator) would be wastefully provided with instructions and data that the propeller owner has no authority to use. The FAA does not agree. The Instructions for Continued Airworthiness must be furnished to the aircraft owner/operator who is the person responsible for maintaining the aircraft (including the propeller). The owner/operator may not be authorized to maintain the propeller, but the owner/operator can place the instructions in the hands of persons who are authorized.

The new Appendix A to Part 35, as adopted, is revised in accordance with comments discussed in Proposal 8-97.

Proposal 8-105. The proposed revision of § 43.9(a)(4) is being deferred for consideration in a forthcoming notice of proposed rule making of the Operations Review Program.

Proposal 8-106. A commenter representing a number of scheduled air carriers is concerned that the use of maintenance manuals and continued airworthiness programs developed under current § 121.133 and Subpart L of Part 121 (generally via Maintenance Review Board procedures), or under similar provisions of Parts 127 and 135, might not be acceptable as "other methods, techniques, and practices" under the terms of proposed § 43.13(a). This commenter suggests that language be added to proposed § 43.13(a) to make this clear. The FAA does not agree. The proposed language states that the use of such manuals and continued airworthiness programs is acceptable.

Proposal 8-107. A commenter representing a number of scheduled air carriers recommends that the Airworthiness Limitations section referred to in proposed § 43.16 include life limitations only and not inspections or other maintenance items. As discussed under Proposal 8-3, the FAA does not agree.

A commenter suggests that the words "or other methods, techniques; and practices acceptable to the Administrator" be added at the end of proposed § 43.16 to make it consistent with proposed § 43.13(a). The Airworthiness Limitations section contains specific mandatory replacement times and inspection intervals (with related procedures) that must be complied with, unless it can be shown by an operator with an approved maintenance program that these times are inappropriate for his operation. The use of alternatives not covered in the Airworthiness Limitations section would be allowed if

approved by the Administrator. Section 43.16 is revised to specifically state the alternatives to compliance with the Airworthiness Limitations section.

Proposal 8–108. No unfavorable comments were received on the proposal to amend § 45.11 to qualify, with respect to manned free balloons, the requirements in § 45.11(a) that deal with the location of the identification plate. Accordingly, the proposal is adopted without substantive change.

Proposal 8–109. No unfavorable comments were received on the proposal to amend § 45.13 to correctly reference §§ 45.11(a) and (b) with regard to identification plate requirements. Accordingly, the proposal is adopted without substantive change.

Proposal 8–110. A commenter representing a number of scheduled air carriers recommends that the words "inspection interval, or related procedure" be deleted from proposed § 45.14. The supporting rationale is the same as submitted by this commenter concerning Proposal 8–3 to amend § 21.31(c). As discussed under Proposal 8–3, the FAA disagrees.

The language in § 45.14 covers rotorcraft as well as airplanes, balloons, engines, and propellers. To make this clear, the word "Rotorcraft" is changed to "Manufacturer's".

Two commenters object to proposed § 45.14 on the grounds that it would be impracticable to mark small parts with a part and serial number. The FAA is not aware that the marking of small parts under current § 45.14 has presented a problem. In any event, the rule allows markings that are equivalent to part and serial numbers, such as symbols enabling the identification of the part as one for which a replacement time, inspection interval, or related procedure is specified in an Airworthiness Limitations section. Identification of such parts is clearly essential for safety. Accordingly, § 45.14 is adopted as revised.

Proposal 8–111. A commenter representing a number of scheduled air carriers recommends that the words "inspection interval, or related procedure" be deleted from proposed § 91.163(c). The supporting rationale is the same as that submitted by this commenter concerning Proposal 8–3 to amend § 21.31(c). As discussed under Proposal 8–3, the FAA disagrees. However, § 91.163(c) is revised to specifically identify the acceptable alternatives to compliance with the "Airworthiness Limitations" section.

The language in proposed § 91.163(c) covers rotorcraft as well as airplanes, balloons, engines, and propellers. To make this clear, the word "Rotorcraft" in § 91.163(c) has been changed to "Manufacturer's", and a statement has been added that operations specifications approved by the Administrator may be used in lieu of the Instructions for Continued Airworthiness. Section 91.163(c) is adopted as revised.

Proposal 8–112. No unfavorable comment was received on the proposal to amend § 91.165 to clarify maintenance personnel entries in maintenance records. Accordingly, the proposal is adopted without substantive change.

Proposal 8–113. Several commenters object to §§ 91.173(a)(2)(i) and (iii). A commenter states that adoption of the proposal would result in an inconsistency between § 91.173 and § 121.380, which contains the recordkeeping requirements for aircraft maintained under Part 121. The commenter also states that this inconsistency would cause great difficulty and economic hardship whenever an aircraft is sold by a Part 121 operator to a Part 91 operator and the Part 91 aircraft is maintained by a Part 121 operator under its repair station certificate. According to the commenter, the economic hardship would occur to both the Part 91 operator and the repair station. The same commenter contends that reliability information accumulated in recent years on transport category airplanes shows that there is no need for individualized total time records on equipment and components. Another commenter states that proposed requirements would result in large increases in maintenance costs for Part 91 operators and that only those components that are life-limited should have to carry total times.

The FAA concludes, however, that revision of § 91.173(a)(2)(i) would contribute significantly to safety with little burden on those affected. The currently prescribed record of total time in service for the airframe does not generally apply to the aircraft's engines

or propellers, since these components are frequently overhauled (or replaced) at different times. As a practical matter, it is known that operators of such aircraft normally keep records from which the total time in service of engines and propellers can be derived. Therefore, the FAA does not agree that the requirement to keep total times on engines and propellers would be a hardship and burden upon the operators. Accordingly, § 91.173(a) (2) (i) is adopted without change.

In light of the comment on proposed § 91.173(a) (2) (iii), the FAA has given further review of the proposal and has concluded that existing requirements satisfy the objective of the proposal. Accordingly proposed § 91.173(a) (2) (iii) is withdrawn.

The reporting and recordkeeping requirements contained in § 91.173 have been approved by the Office of Management and Budget in accordance with the Federal Reports Act of 1942.

Proposal 8–114. Several commenters agree with the intent of proposed § 91.193(c) (4) but suggest changes. A commenter suggests that the proposed installation instructions for hand fire extinguishers would be more appropriately placed in the type certification rules. The FAA does not agree. New type certification rules do not apply to aircraft already in service.

A commenter suggests that the words "unless obvious" be added to clarify when the hand fire extinguisher stowage provisions must be properly identified. The FAA agrees. Proposed § 91.193(c) (4) is revised and adopted accordingly.

Proposal 8–115. One commenter objects to the proposal to revise § 91.197(a) to require passenger information signs to meet the requirements of § 25.791. The commenter states that it is unnecessary, in many small general aviation aircraft operating under Subpart D of Part 91, to have such signs just for the sake of uniformity. The commenter also states that "nonstandard" signs now in use are wholly adequate to meet the needs of the type of operation. Finally, the commenter points out that installation costs for aircraft not currently having signs would be high and the pilot could just as easily announce the information as he could activate the signs.

Based on these comments and considering the type of operation involved, the FAA finds that the benefits associated with the proposal do not warrant its adoption. The proposal to revise § 91.197(a) is withdrawn.

Proposals 8–116, 8–117, 8–118, and 8–119. Final action on Proposals 8–116, 8–117, 8–118, and 8–119 was taken in Airworthiness Review Program, Amendment No. 8: Cabin Safety and Flight Attendant Amendments (45 FR 7750; February 4, 1980).

Proposal 8–120. In light of the need to conduct further testing of protective breathing equipment, the FAA withdraws its proposal to amend § 121.337, which will be addressed in an upcoming notice of proposed rule making.

ADOPTION OF THE AMENDMENT

Accordingly, Parts 11, 21, 23, 25, 27, 29, 31, 33, 35, 43, 45, and 91 of the Federal Aviation Regulations are amended, effective October 14, 1980.

(Sections 313(a), 601, 603, and 604 of the Federal Aviation Act of 1958 (49 U.S.C.1354(a), 1421, 1423, and 1424)); and Section 6(c) of the Department of Transportation Act (49 U.S.C.1655(c)))

The FAA has determined that this document involves a regulation which is not significant under Executive Order 12044, as implemented by Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). A copy of the final evaluation prepared for this document is contained in the docket. A copy of it may be obtained by writing to the individual and address listed in the "For Further Information Contact" paragraph.

Amendment 33-10
Aircraft Engine Regulatory Review Program; Aircraft Engine and Related Powerplant Installation Amendments

Adopted: December 16, 1983 **Effective: March 26, 1984**

(Published in 49 FR 6832, February 23, 1984)

SUMMARY: This amendment updates the airworthiness standards applicable to the type certification of aircraft engines and of aircraft with respect to engine installations. The changes implement the President's Regulatory Reform Program by simplifying a number of technical requirements, by eliminating unnecessary rules where appropriate, and by removing administrative burdens on regulated persons and the FAA through amendment of regulations from which exemptions have been granted. The regulations update and modernize technical requirements to reflect engineering advances in the state-of-the-art and take into account accumulated service experience and recommendations of the National Transportation Safety Board (NTSB).

FOR FURTHER INFORMATION CONTACT: George F. Mulcahy, Engine and Propeller Standards Staff, ANE-110, Aircraft Certification Division, New England Region, Federal Aviation Administration, 12 New England Executive Park, Burlington, Massachusetts 01803; telephone: (617) 273-7330.

SUPPLEMENTARY INFORMATION:

BACKGROUND

Following recodification in 1965, the first significant revision to the Code of Federal Regulations (CFR) Title 14, Part 33—Airworthiness Standards: Aircraft Engines, was made late in 1974 by Amendment 33-6. The amendment sought to accommodate the increasing complexity of airframes and engines and their interfaces and the further impact of supersonic flight. During ensuing years, as the industry became even more complex and specialized, the need for clarification and elimination of redundancies in test and design requirements became evident.

Responding to these needs, the FAA in mid-1977 announced an Aircraft Engine Regulatory Review Program, solicited rule change proposals from the aviation and general community, and held a week-long Regulatory Review Conference in January 1978, attended by over 100 industry and public representatives.

Based on information received during the review program and conference, the Administrator issued Notice of Proposed Rulemaking (NPRM) 80-21, Aircraft Engine Regulatory Review Program; Aircraft Engine and Related Powerplant Installation Proposals (45 FR 76872; November 20, 1980), which proposed to upgrade the airworthiness standards applicable to the type certification of aircraft engines and of aircraft with respect to engine installations. Comments on the proposals were invited until February 18, 1981.

Interested persons now have been given an opportunity to participate in the making of these amendments, and due consideration has been given to all matters presented. The proposals and comments are discussed below. Substantive changes and changes of an editorial and clarifying nature have been made to the proposed rules based upon relevant comments received and further review within the FAA. Except for minor editorial and clarifying changes and the substantive changes discussed below, these amendments and the reasons for them are the same as those proposed and explained in Notice 80-21.

DISCUSSION OF COMMENTS

The following discussion summarizes the comments received from the public, from industry, and from foreign authorities. Proposals are numbered as in Notice 80-21.

Proposal 1. This amendment clarifies § 23.901(d), which calls for a determination that installation effects do not cause any deterioration of powerplant rain ingestion

tolerance as demonstrated by the engine in compliance with the engine certification standards of § 33.77.

One commenter advises that it is not clear whether a specific determination for deterioration of powerplant rain ingestion tolerance is required for the intake-engine combination or whether the test of Part 33 would suffice. The intent of the proposed rule is to ensure that installation effects do not result in any deterioration of powerplant rain ingestion tolerance. This requires a separate determination for the engine installation, other than that required by 14 CFR Part 33.

A commenter recommends that flight idle be included in the evaluation of operation in rainfall conditions. The FAA agrees that the regulation, as proposed, does not specify operating conditions for the rain ingestion investigation and the operating conditions of takeoff and flight idle are added to the rule as adopted.

One commenter recommends that the specified liquid water content be compared to engine induction airflow rate. It is the intent of the regulation to proportion the ingested liquid water content in relation to the induction airflow, and this recommendation would afford clarification. Therefore, the proposed rule is revised by adding the phrase "4 percent of engine airflow by weight."

A commenter recommends that the requirement for 3 minutes of operation at flight idle in rain be deleted. The FAA disagrees. Satisfactory operation of an engine for 3 minutes at flight idle in the rain conditions specified will provide assurance that it will satisfactorily operate throughout the rain conditions likely to occur in service. The 3-minute time period is therefore retained.

A commenter recommends that the regulations be clarified by removal of words such as "safe" and "hazardous," which are considered ambiguous. The FAA believes that these words have a common interpretation in aviation and that § 23.901 is sufficiently clear without further change.

Proposal 2. This amendment to § 23.903(a) permits the installation of an engine approved under standards other than those of 14 CFR Part 33, such as Part 13 of the Civil Air Regulations (CAR) or Part 21 of the Federal Aviation Regulations (FAR). In addition, provision is made for approving installation of a type certificated engine on the basis of satisfactory service experience if the engine has not specifically complied with § 33.77. Proposed § 23.903(b) also will require that precautions be taken in the design of aircraft to protect vital components from the effects of uncontained rotor failures and engine fires.

Four commenters request that § 23.903(a) be revised to include reference to § 21.29(a) (1) (ii), which pertains to certification of import products. To be eligible for installation in a U.S. type certificated aircraft, an engine must have a U.S. type certificate. Engines imported from a foreign country type certificated in accordance with § 21.29 are covered by the amended wording of § 23.903(a), and no further action is required.

One commenter advises that under the proposed wording of § 23.903(a) (2) (i) existing engines could be disqualified each time § 33.77 was amended, a condition which would be unreasonable. The intent of this rule change is to ensure an acceptable level of safety for all engine installations with relation to foreign object ingestion (FOI). A certificated engine which has shown compliance with an approved standard and has had a satisfactory FOI service history when installed in a similar aircraft location will continue to be eligible for installation in an aircraft under paragraph (a) (2) (ii). Therefore, no further change to the proposed rule is necessary.

A commenter advises that the proposed wording of § 23.903(a) (2) (ii) would deny an applicant the right to apply service experience from a particular aircraft engine installation to justify certification at a different location on the aircraft. The commenter states that there is no proof that some installation locations have a higher frequency of ingestion than others, wing mounted versus aft mounted, for example, nor has frequency of ingestion been found to be related to engine capability to withstand ingestion of objects. FAA policy is to certify engines independently of installation location and/or number of engines per aircraft. Nevertheless, when satisfactory service experience is used as a basis

of approval of an engine installation, the location of the engine during the time this experience was accumulated must be considered to determine whether the new installation is more or less subject to FOI, and whether similar results may be expected in the proposed installation. This policy is adequately expressed in the proposal, and no further change is necessary.

One commenter recommends clarifying § 23.903(a) with a third qualifying condition: that the engine be shown to comply with § 33.77 in effect at the time of engine type certification. The FAA has determined that addition of a third alternative might result in an unacceptable level of safety under FOI conditions. Section 33.77 in effect October 1, 1974, or thereafter is specifically referenced to preclude this eventuality.

A commenter recommends that § 23.903(b) be revised to specify the areas needing protection from rotor burst, such as fuel systems, flight control systems, and occupied areas of the fuselage. The FAA notes that areas which may be critical in one aircraft with respect to the effects of rotor burst may not be critical in another. Accordingly, it is left to the designer to determine which areas must be protected and how to protect them, and the proposed general language provides such latitude. However, the FAA will evaluate such design for compatibility with the intent of this regulation.

One commenter objects to the wording of the proposed regulation and does not consider turbine engine rotor failure or casing burn-through a problem for small aircraft engines. Turbine engine rotor failure has been reported in small turbine engines, although problems have not been noted in recent years. As long as the potential for failure continues to exist, however, the problem should remain under consideration. Measures taken to protect aircraft from effects of rotor burst also are expected to resist burn-through. Proposed § 23.903(b) as drafted ensures protection appropriate to the risk involved and is therefore adopted as proposed.

Proposal 3. This amendment revises existing § 23.905 to allow installation of a propeller approved under standards other than 14 CFR Part 35. Commenters agree with this rule change. Therefore, except for deletion of the qualifier "approved," which is not applicable in reference to a type certificate, the rule is adopted as proposed.

Proposal 4. This amendment to § 23.975(b) requires that each fuel injection engine employing vapor return provisions, as well as carburetor engines having such provisions, have a separate vent line to return vapor to the vapor space in one of the fuel tanks. Four commenters recommend that the proposed regulation be revised to require fuel vapor to be returned to the fuel tank but not specifically to the vapor space, provided the return line location is carefully selected. However, carburetors with vapor elimination features currently in service have a very low return fuel pressure with which to overcome flow resistance in the line, so that the static fuel pressure head at a particular location might be sufficient to prevent proper venting of the carburetor. Also, discharging the vapor return line into the fuel tank at a location near the fuel tank outlet could result in vapors being reintroduced to the engine with subsequent loss of power. The proposed amendment is changed in accordance with these comments to specify that the vapor be returned to the top of one of the fuel tanks.

One commenter recommends that it would be preferable to return the vapor to the selected tank (the tank being used). The FAA agrees but considers this requirement to be a substantial change which would add significant complexity and cost to the fuel system of airplanes certificated under Part 23 without a commensurate increase in safety.

Proposal 5. This amendment to § 23.994 redefines the required protection against fuel spillage in terms of that occurring after wheels-up landing on a paved runway. One commenter questions whether any amount of fuel spillage should be allowed during a wheels-up landing. Another suggests that a specified amount of spillage would be more appropriate. The FAA agrees that it would be desirable to prevent any fuel spillage during a wheels-up landing on any type of landing surface, but it also recognizes that release of minute quantities of fuel would not be likely to present a fire hazard and that complete avoidance of fuel spillage or approval of a specific amount would be very difficult. Therefore, the regulation is adopted as proposed.

Proposal 6. This amendment adds a new § 23.995(g) specifying that fuel tank selector valves must take a separate and distinct action to place the selector in the "OFF" position and that the selector must not pass through the "OFF" position when changing from one tank to another.

One commenter recommends that the proposed wording be changed to read "The valve shall be designed so that it is not necessary to move the selector through 'OFF' position when switching tanks." The FAA believes that the proposed phrasing is more positive, and the rule is adopted in this form. This change is in accordance with National Transportation Safety Board (NTSB) Safety Recommendation No. A–79–72.

Proposal 7. Part of the proposed amendment to § 23.997 was intended to make it clear that an aircraft manufacturer need not duplicate equipment or tests of fuel strainers or filters if they were provided and approved as part of a certificated engine and if they also meet the requirements of this subpart. The proposed wording, however, inadvertently exempted such provided equipment from the latter requirement. The intended relief is already provided as an option to aircraft and engine manufacturers under the current rule. Therefore, the portion of the proposed rule exempting engine-supplied devices is withdrawn.

The rule also corrects terminology and relieves design requirements for mounting fuel strainers or filters.

Commenters question the meaning of the words "fuel metering device," recommend that filtration standards be included for the filters/strainers, and recommend that the fuel filter be placed ahead of any other fuel system component subject to contamination. The FAA has determined that a fuel metering device is commonly understood to be one which regulates or "meters" fuel flow and that fuel filtration standards should not be included in the regulation but covered by policy material. The rule, in conjunction with § 23.977, assures that filters and strainers are properly located to prevent contaminants from blocking components other than pumps and controls. In some installations the suggested locations would in fact be unfeasible.

Proposals 8 and 9. The proposed changes to §§ 23.1013 and 23.1015, which deal with oil tanks approved and provided as part of an engine, are withdrawn for the same reasons given in Proposal 7 for withdrawing the portion of the wording exempting engine-supplied devices.

Also, a commenter questions whether an equivalent provision originally proposed for Part 25 applies to engines certificated to the standards of Part 33 before Amendment 33–6 and suggests that this be clarified. The commenter asserts that the oil tanks may be unsafe if not substantiated under Amendment 33–6. The concern expressed by the commenter has been taken into account by withdrawing the proposal.

Proposal 10. This change to § 23.1019 corrects terminology and is intended to relieve the airplane manufacturer from duplicating compliance with oil strainer/filter design requirements if they are provided and approved as part of the engine to be installed. The proposed rule, except for that portion which corrects terminology, is withdrawn for the reasons given in Proposal 7.

One commenter recommends that oil filtration standards be included in the regulations. The FAA believes that filtration standards would be more appropriately covered by an advisory circular or equivalent advisory information.

Proposal 11. This proposal amends § 23.1021 to permit the use of multiple oil system drains, if necessary, to provide more efficient drainage. All commenters agree with the change, and the regulation is adopted as proposed.

Proposal 12. The proposed change of § 23.1093 brings the ground idle induction system icing test conditions into conformance with Appendix C of 14 CFR Part 25 and permits periodic operation at increased power or thrust higher than ground idle as an ice protection measure.

One commenter questions whether "momentary operation at takeoff power" is adequate. Another commenter questions whether allowing engine runup on an icy taxiway

would be a safe condition. The FAA agrees that the second comment may have merit under certain conditions. However, the relaxatory nature of this part of the regulation need not be denied applications where safety is not compromised. On icy runways, the decision to use momentary power or thrust to remove induction ice would remain with the flightcrew. The first comment addresses part of the current regulation not raised under Notice 80-21 and therefore is outside the scope of the proposed change.

One commenter recommends a referenced military specification, MIL-E-5007D, which would be a somewhat more severe requirement (25°F, mean effective drop diameter 30 microns, and .4 grams per cubic meter liquid water content). Actual meteorological data, as presented at the Aircraft Engine Regulatory Review Conference, does not support this severe a requirement. It is considered that the revised test criteria take into consideration actual ground icing conditions, including an adequate margin of safety, and that compliance with MIL-E-5007D is not warranted. Therefore, § 23.1093 is adopted as proposed.

Proposal 13. This proposed change would add a new § 23.1143(e) to: (1) state engine control requirements not only for antidetonant injection (ADI) systems, but for other fluid injection systems (other than fuel) as well; (2) make it clear that any fluid injection system and its controls provided and approved as part of the engine need not be duplicated by the aircraft manufacturer; and (3) specify a separate control for fluid injection pumps.

Five commenters object to proposed § 23.1143(e) (1) on the grounds that it restricts design of fluid control to one of a number of satisfactory types. It is their view that fluid injection requirements are influenced by other factors which may not relate to the amount of power produced by an engine in service. In some cases, the engine installations have fluid systems that do not vary the fluid flow with power. Fluid is injected in a fixed amount, and power is varied by the engine fuel control via the power lever. The proposed paragraph is rephrased to permit more flexibility in design.

One commenter requests that the regulations be clarified so that separate control for fluid injection pumps is required regardless of whether or not the injection system is approved as part of the engine. Another suggests deletion of this paragraph as some current systems do not use pumps. The FAA agrees with the commenters, and the proposed regulation is revised accordingly.

The portion of the proposed rule exempting engine-supplied devices from the requirements of this section is withdrawn for the reason given for § 23.997.

Proposal 14. This amendment revises § 23.1163(a) to make it clear that it is the ultimate responsibility of the aircraft manufacturer who installs an engine to assure proper sealing of engine oil lubricated accessories.

Three commenters request clarification of paragraph (a) (3) to define what is to be sealed. The FAA concurs that the intent is unclear and proposed paragraph (a) (3) is changed to define the extent of sealing.

Proposal 15. The amendment to § 23.1183 would raise the limiting capacity of reciprocating engine oil sumps from 20 to 25 quarts before fireproofing or shielding is required. Also, the regulation exempts components, as well as lines and fittings that have been approved as part of the engine, from these requirements. These changes remove unjustified engine design limitations and afford increased range capabilities.

One commenter recommends that the 20-quart capacity limit required by paragraph (a) be retained. The proposal is seen as an arbitrary accommodation of a particular application for type certification, but the commenter does not supply specific information or data to support this claim. A search of FAA records has not disclosed such an application.

Neither service with 20-quart capacity oil systems nor any other evidence has shown that there would be any compromise of safety associated with a sump capacity of 25 quarts of oil as opposed to 20 quarts in the case of a powerplant fire. The amendment is adopted as proposed.

Proposal 16. This amendment to § 23.1189(a) (1) and (b) (2) clarify the requirements for shutoff means for flammable fluids in multiengine aircraft and for turbine engine oil systems.

One commenter recommends that this rule be cross-referenced to 14 CFR Part 33. Another commenter suggests addition of the word "installation" to paragraph (a) (1) for the sake of clarity.

The FAA does not consider a cross reference to Part 33 necessary since the emphasis of this section is upon the aircraft manufacturers' responsibility to ensure a fireproof engine installation. Adding the word "installation," however, will provide additional clarification. The proposed regulation is adopted with this change.

Other comments contain proposals for Part 23 which were not on the agenda of the Aircraft Engine Regulatory Review Program. These include the addition of a new § 23.907 concerning acceptable propeller stress levels and addition of a rule requiring that positive pressure be maintained within fuel tanks to prevent vapor formation. These recommendations are outside the scope of the proposed amendment and are not addressed by this rulemaking.

Proposal 17. This revision of § 25.33(a) (2) corrects and updates an obsolete reference to the rules and does not constitute a substantive change. No unfavorable comments were received, and the proposal is adopted.

Proposal 18. No unfavorable comments were received with respect to revising § 25.697(a) to correct reference to obsolete rules. The proposal is therefore adopted without change.

Proposal 19. For a discussion of comments on the proposed amendment to § 25.903(a), see the proposal for § 23.903(a).

Proposal 20. This proposal revises § 25.905(a) to allow installation of a propeller type certificated under the procedures of CAR Part 14 or § 21.29 of the FAR, as well as Part 35 of the FAR. No unfavorable comments were received with respect to revising § 25.905(a). Therefore, except for deletion of the qualifier "approved," which is not applicable in reference to a type certificate, the rule is adopted as proposed.

Proposal 21. Six commenters object to and recommend deleting the proposed change to § 25.939(b). The consensus is that determination of surge and stall margins in quantitative terms is beyond the current state-of-the-art and that adequate investigation of engine stall, surge, and flameout characteristics is currently covered by the requirements of § 25.939(a). Therefore, the proposed change to § 25.939(b) is withdrawn. The comparable proposal to amend § 33.65 also is withdrawn.

Proposal 22. This amendment to § 25.961 restores test conditions for hot weather fuel system operation previously deleted.

One commenter recommends deleting proposed paragraph (a) (4) (i) (D), arguing that the center of gravity is not relevant to hot fuel tests. This reference to the most unfavorable center of gravity was continued over from the deleted § 25.65(a) (4) as one of the conditions for demonstrating all engine climb in cruising configuration. The FAA agrees that unfavorable center of gravity is not relevant to the hot fuel test, and paragraph (a) (4) (i) (D) of the proposed change is deleted. The proposed amendment is adopted as revised.

Proposal 23. For a discussion of comments on and disposition of the proposed amendment to § 25.994, see the proposal for § 23.994.

Proposal 24. For a discussion of comments on and disposition of the proposed amendment to § 25.997, see the proposal for § 23.997.

Proposal 25. The proposed revision of § 25.1001 removes the distinction between fuel jettisoning systems for reciprocating and turbine engine-powered airplanes, deletes obsolete sections, and corrects references to climb performance sections. Other changes are editorial in nature, eliminate redundancies, and clarify the text.

No unfavorable comments on the proposed change of § 25.1001 were received. However, two commenters recommend rephrasing the requirement of paragraph (d) (3) to specify that fuel or fumes do not enter any part of the airplane in sufficient quantity to constitute a fire or explosion hazard, maintaining that not all fuel or fumes necessarily constitute a fire or explosion hazard. A third commenter recommends revising paragraph (b) to rectify a condition in which the intended reduction in airplane weight cannot be achieved when jettisoning is initiated with the fuel quantity and distribution associated with takeoff at maximum zero fuel weight (that is, for short range with high cabin load).

Fuel or fumes should not be allowed to reenter any part of the airplane during an emergency condition such as jettisoning. It would be difficult to establish the amount of fuel or fumes that does constitute a hazard. Regarding the wording in paragraph (b), the FAA agrees that the comment has merit; however, it is outside the scope of the proposed change. The rule is adopted as proposed.

Proposals 26 and 27. No unfavorable comments were received in response to the proposed changes to §§ 25.1013 and 25.1015. However, the portion of the proposals dealing with oil tanks provided and approved as part of an engine is withdrawn for the reasons stated for § 23.997. For a discussion of reciprocating engine oil sump capacity in relation to fireproofing requirements in § 25.1013, see the proposal for § 23.1183.

Proposal 28. No adverse comments were received on the proposal to amend § 25.1019, and the change is adopted as proposed. For a discussion of this change, see the proposal for § 23.1019.

Proposal 29. No adverse comments were received on the proposal for § 25.1021, and it is adopted as proposed (See the proposal for § 23.1021).

Proposal 30. This amendment to § 25.1045(d) corrects references to performance requirements which have become obsolete. In addition, a commenter would delete the cooling test configuration center of gravity requirement as irrelevant. Another commenter suggests the following rewording: ". . . the most unfavorable center of gravity position at which the airplane can be flown safely."

Reference to the most unfavorable center of gravity was carried over from deleted § 25.67, which governed demonstration of one engine inoperative climb. Section 23.121(c) is the new reference, and it has no requirement for center of gravity position. In any case, the airplane must be flown within the airplane limitations.

The FAA agrees that for this cooling test the effect of center of gravity position is negligible and does not affect the outcome. The proposed amendment is revised and adopted.

Proposal 31. This amendment to § 25.1091(e) requires the foreign object ingestion criteria of § 33.77 to be applied to vulnerable portions of induction systems.

Comments received were generally favorable. Two commenters recommend, however, that additional wording be included to specify the air induction system parts or components to be considered under this rule.

The FAA believes that the proposed change adequately states the performance objectives of the airplane air induction system and the criteria to be applied. Listing specific components to be protected would ignore possible future developments. The change to § 25.1091(a) therefore is adopted as proposed.

Proposal 32. For a discussion of comments on and disposition of the proposed amendment to § 25.1093(b) (2), see the proposal for § 23.1093(b) (2).

Proposal 33. For a discussion of comments and disposition of the proposed amendment to § 25.1143(d), see the proposal for § 23.1143(e).

Proposal 34. For a discussion of comments on and disposition of the proposed amendment to § 25.1163(a), see the proposal for § 23.1163(a).

Proposal 35. For a discussion of comments on and disposition of the proposed amendment to § 25.1183(b) (1), see the proposal for § 23.1183(b) (1).

Proposal 36. For a discussion of comments on and disposition of the proposed amendments to § 25.1189(a) (1) and (2), see the proposals for § 23.1189(a) (1) and (b) (2).

Proposal 37. This amendment would have deleted § 25.1305(d) (3), which calls for a rotor system unbalance indicator in each turbojet installation.

One commenter disagrees, stating that the requirement should be retained and arguing that foregoing the monitoring of airborne vibration would be a retrograde step. The commenter claims that well developed systems have shown more than adequate reliability and are considered capable of giving advance warning of impending failures.

Service experience has not shown that installation and use of airborne vibration monitor (AVM) systems are universally beneficial, as they are not totally effective in providing advance warning of all hazardous engine failure modes. However, recent experience, since this amendment was proposed, has demonstrated the potential of an AVM to provide a safety improvement as discussed by the first commenter. Therefore, the proposal to delete § 25.1305(d) (3) is withdrawn pending further study.

Proposal 38. No unfavorable comments were received regarding the proposed change to § 25.1323(b) (2), which deletes an obsolete reference to § 25.59, and it is adopted without change.

Nonsubstantive changes are made to §§ 25.1359 and 25.1521 which were not included in the Regulatory Review Conference Agenda or in Notice 80–21. These amendments correct typographical errors and references.

Proposals 2 and 19 modify §§ 23.903(a) and 25.903(a), respectively, to require an "approved type certificate" for each engine installed, rather than a type certificate issued under Part 33 only. The discussion presented for the proposal for § 23.903(a) also applies to §§ 27.903(a) and 29.903(a). Therefore, substantively identical changes to these actions are adopted.

A commenter suggests that in connection with the revised wording, turbine engines installed in rotorcraft should be required to comply with the foreign object ingestion requirements of § 33.77, which is now the case for engines type certificated after October 1, 1974. For engines for which application for type certificate was made before that date, this suggestion constitutes a substantive change beyond the scope of this rulemaking and is not adopted.

Proposal 39. For a discussion and disposition of the proposed amendment to § 27.997, see also the proposal for § 23.997.

One commenter questions the rationale behind deleting the phrase "and the mesh" and claims that without this phrase only filter capacity is addressed by the rule. The term "mesh" is not applicable to filters or filter elements. However, fuel filtration requirements, including mesh, particle size, and density, if not satisfied by the engine manufacturer, will be prescribed in the instruction manual for installing and operating the engine (§ 33.5). Therefore, in this case, compliance would be assured by reference to § 33.5 in § 27.901(c) (1) and the requirements in § 27.977 (§§ 29.901(b) (1) (i) and 29.977 for Part 29).

Proposals 40, 41, 42 and 43. For discussion and disposition of the proposed amendments to §§ 27.1013, 27.1015, 27.1019, and 27.1021, see the proposals for §§ 23.997, 23.1019, and 23.1021.

Proposals 44 and 54. These proposals would delete §§ 27.1093(b) (2) and 29.1093(b) (2), which are the current requirements for demonstrating satisfactory powerplant operation when exposed to atmospheric icing during ground operating conditions. The basis for deletion is the contention that engine induction system icing during ground idle operation has not been a significant problem with rotorcraft, assuming they are not required to queue up for takeoff as are airplanes. Subsequent FAA review of rotorcraft utilization discloses that extended ground operation of rotorcraft during icing conditions, although infrequent, must be expected. The proposals to delete §§ 27.1093(b) (2) and 29.1093(b) (2) therefore are withdrawn and the sections are reworded as in §§ 23.1093(b) (2) and 25.1093(b) (2).

For further discussions on this amendment, see Proposal 75 for § 33.68 and Proposal 12 for § 23.1093.

Proposals 45 and 55. These amendments add new §§ 27.1143(d) and 29.1143(d) and (e) specifying that fluid injection (other than fuel) controls be in the throttle controls and eliminating duplicate certification requirements, as in §§ 23.1143 and 25.1143. However, the term "throttles" is a misnomer for modern turbine engines installed in rotorcraft. Changes needed to rectify the terminology would be beyond the scope of this review. The proposals to amend §§ 27.1143 and 29.1143 are withdrawn and will be referred to the Rotorcraft Regulatory Review Program for consideration.

Proposals 46 and 56. For a discussion and disposition of the proposed amendments to §§ 27.1163(a) and 29.1163(a), see the proposal for § 23.1163(a).

Proposals 47 and 57. These amendments to §§ 27.1183 and 29.1183 establish a new capacity limit of 25 quarts instead of 20 quarts for reciprocating engine integral oil sumps before requiring the sumps to be fireproof or have fireproof shielding. For a discussion of comments on and disposition of the proposals, see the proposal for § 23.1183.

Proposals 48 and 58. For a discussion and disposition of the proposed amendments to §§ 27.1189 and 29.1189, see the proposal for § 23.1189.

Proposals 49, 50, 51, 52, and 53. For discussion and disposition of the proposed amendments to §§ 29.997, 29.1013, 29.1015, 29.1019, and 29.1021, see the corresponding proposals for Part 23.

Proposal 59. This amendment to § 33.7 revises the engine operating limit requirements for fuel and oil temperature and pressure, overhaul, and windmilling r.p.m.

All comments support adoption of this proposal. Additionally, two commenters propose changing Appendix A of Part 33 to be compatible with deleting the word "overhaul," as proposed in the amendments to §§ 33.7(c)(17) and 33.90. However, reference to the term "overhaul" is still appropriate to many turbine and basically all reciprocating engines. While the FAA believes there is merit in considering a restructuring of Appendix A, it goes beyond the scope of the Notice 80-21. Accordingly, the amendment is adopted as proposed.

Proposal 60. This amendment to § 33.14 revises and clarifies the rules establishing engine low-cycle fatigue limits.

One commenter suggests that the definition of start-stop cycle fails to account for reduced power takeoff and therefore should be modified to read ". . . accelerating to takeoff thrust levels . . ." rather than ". . . accelerating to maximum rated power or thrust. . . ." Reduced power takeoff is an operational procedure determined by prevailing factors such as aircraft weight, runway length, and density altitude. The FAA believes the fatigue life used for certification should be the minimum service life based on maximum ratings since the engine operational characteristics will vary for each aircraft installation. Both cyclic and hourly life credits for reduced stress levels experienced by some discs during reduced power takeoff can be adjusted by the use of approved methodology. One engine manufacturer has done so by creating "disc life factors" to apply to those cycles or hours of operation under required conditions. The established life thus has a certain conservative bias, as it is based on maximum ratings.

Another commenter objects to the proposed wording of this section because it eliminates the distinction between maximum predicted and initial service life and suggests that a part could continue in service up to its maximum predicted life without undergoing the specified sampling program. The commenter suggests that some fixed percentage of the predicted life be established as the initial service life. The FAA does not agree that a lack of distinction will exist between initial and predicted life. The predicted life of a disc is evaluated by the applicant using approved low-cycle fatigue methodology involving factors such as material properties, engine thermodynamics, etc., which when used in the analysis result in a confidence level for the predicted life. Based on this confidence level, the service life may vary from one-third to three-fourths or more of the predicted life. To require the initial service life to be a fixed proportion of the predicted life, i.e., 50 percent for instance,

would place an undue burden on the applicant with no commensurate safety benefit. Any program to increase the initial service life must include sampling or inspection procedures. For these reasons, the rule, except for some editorial changes, is adopted as proposed.

Proposal 61. No unfavorable comment was received on the proposal to amend § 33.15(b) by deleting the phrase "or Technical Standard Orders," given erroneously as a standard for engine materials, and the proposal is adopted without change.

Proposal 62. This amendment to § 33.17 increases the limiting oil capacity for reciprocating engine integral oil sumps from 20 to 25 quarts before fireproofing is required.

One commenter takes exception to the wording of § 33.17(a), which implies that any structural failure or overheating in turbine engines would represent a hazardous condition. The same language has been carried under deleted § 33.17(f) and has presented no problems in interpretation.

A commenter recommends that the present 20-quart oil limit be retained, implying that it was established by fire testing. The FAA has no records which show that the 20-quart limit was derived from fire test data. Its original intent was to exclude the integral oil tanks of small reciprocating engines from fireproofing requirements, and it was based on years of satisfactory service experience. The FAA does not believe that raising this limit to 25 quarts as proposed will violate the original intent (see also the proposal for § 23.1183). Since the 25-quart limit was proposed over 4 years ago, the FAA has received no evidence that would indicate this change would compromise safety. Therefore, the amendment is adopted as proposed.

Proposal 63. This amendment to § 33.19(a) requires an applicant for an engine type certificate to define the trajectories of rotor blade fragments exiting outside compressor or turbine rotor cases.

Two commenters object to the last word of § 33.19(a) in that it is unduly restrictive. The commenters state that the requirement that fragment energy levels and trajectories be "defined" can be interpreted to mean precisely defined by tests, whereas in practice they may be determined by engine tests, component tests, and/or analysis. The FAA disagrees that use of the word "defined" is unduly restrictive. It is the FAA's intent that the boundary condition for possible fragments be set and therefore defined. The method used may include engine tests or other means acceptable to the Administrator.

Another commenter suggests that a corresponding change be made to § 33.5 to provide for the location of the data on fragment energy levels and trajectories. However, a change to § 33.5 is not required since the actual location of this data will be referenced on the engine data sheet.

Another commenter suggests a clarification of the rule is required to specify that only where fragments leave the engine through the inlet or turbine exhaust should the energy and trajectories be defined. The FAA believes this clarification is unnecessary. The first portion of the current rule requires containment of damage from blade failures. The new sentence would require definition of the boundary conditions for debris generated by the blade failure and ejected by the engine. It is this possible secondary damage due to debris exiting the inlet, fan, or core exhaust that is pertinent. Accordingly, the proposal is adopted without change.

Proposal 64. This revision of § 33.23 refines definitions and load limits for engine mounting attachments and structure.

Several commenters suggest changing § 33.23(b) to make the wording similar to the aircraft primary structural requirements of §§ 23.305(a) and (b) and 25.305(a) and (b). It is suggested that "permanent deformation in § 33.23(b)(1) be changed to "detrimental permanent deformation." This change would recognize the slight deformations associated with structural hysteresis which do not adversely affect the structure.

It is further suggested that any deformation at limit load which interferes with engine operation should not be permitted, although § 33.23 does not so state, and that the § 25.305, 3-second criterion for demonstration of ultimate load is also appropriate for

§ 33.23(b) (2); otherwise, the rule could be interpreted to require the structure to withstand ultimate load for an indefinite period of time.

The FAA believes that the primary structural requirements of § 25.305 are appropriate where a variety of designs serving the many structural needs of an aircraft must be evaluated under a single rule. Engine mounting attachment structure represents a much narrower range of design for which the additional provisions of § 25.305 are not needed. Current practice and service experience support this opinion. Therefore, the wording "permanent deformation" is retained.

One commenter would also specify that the engine mounting attachments and structure withstand repeated application of normal loads; that is, there should be fatigue substantiation of critical structural components. Although not currently required, engine mounting attachments and structures are in fact being confirmed under repetitive loading. Adopting this requirement would, however, add regulatory demands beyond those of the proposal. The question of requiring substantiation of mounting attachments and structures under cyclic loads will be considered for future rulemaking action.

One commenter suggests inserting the word "engine" in § 33.23(a) and (b) to modify "structure" and thus avoid implying that aircraft structure is meant. The FAA agrees, and the proposal is adopted with the wording changed accordingly.

Proposal 65. No unfavorable comment was received on the proposal to amend § 33.25 to delete an unnecessary sentence relating to load requirements already specified in § 33.49(a) and § 33.87(a) (6) for reciprocating and turbine engines, respectively. The amendment permits a minute amount of oil leakage from the engine interior and assigns ultimate responsibility for engine/accessory drive sealing to the aircraft manufacturer. Accordingly, the amendment is adopted as proposed.

Proposal 66. This amendment to § 33.27 revises overspeed test conditions and strength requirements for turbine, compressor, and turbosupercharger rotors and extends these criteria to fan rotors.

Two commenters object to the proposed wording of the posttest acceptability criteria in the last sentence, stating that it is unnecessarily loose and subject to varied interpretation. The FAA disagrees. The intent of the test is to ensure that compressor and turbine rotors have sufficient structural strength to provide reliability and safety during an inservice overspeed situation. The acceptability criterion is that parts show no evidence of incipient failure or distortion which could cause hazards. Such evidence will differ for each engine type design, and a determination must be made for each case. Although the wording of the current rule is revised, it continues to state that for each type design a proven acceptable condition must be met and demonstrated.

Two commenters recommend that § 33.27(c) (2) (v) and (vi) need not apply if the failure events described are considered improbable. The FAA disagrees. Service experience shows that most severe engine failures, including those caused by disc and shaft failures, would have been judged improbable beforehand. Attempts to apply probability to this rule would not be in the interest of airworthiness.

Two commenters request that maximum permissible r.p.m. be defined as the highest steady state r.p.m. at which an engine shaft can rotate in service. The FAA disagrees. If an engine has a transient rotor speed limitation higher than the steady state limitation, maximum permissible r.p.m. would be the maximum transient speed limit.

Another commenter suggests rearranging § 33.27(c) (2) for clarification and allowing rotor discs with sections thinner than type design to be used to produce equivalent stresses at lower r.p.m. The FAA does not believe that the proposed rearrangement of paragraph (c) (2) would significantly clarify the requirements of the section. While the use of thinned rotor discs as test articles may be justified under certain circumstances, the practice should not be considered typical or normal. The conditions under which this expedient might be acceptable must be evaluated on an individual basis and a determination of equivalency made. Accordingly, the amendment is adopted as proposed.

Proposal 67. This amendment proposes to delete § 33.29(b), which requires that each turbojet engine be provided with a connection for a rotor system unbalance indicator.

A commenter objects to deletion of the requirement for a connection for rotor system unbalance indication. The commenter states that a well-developed system has more than adequate reliability and has capability of giving advance warning of failures which could lead to hazardous events. Two commenters agree to the deletion of the requirement for rotor system unbalance indication. However, one of the commenters adds that airborne vibration monitoring (AVM) could be applicable to some engines and that in cases where reliable AVM systems have been developed, credit could be claimed for the AVM system in showing compliance with various FAR Part 33 (and Part 25) requirements as part of the basic engine type design. Recent experience has demonstrated that in some instances AVM can provide a safety improvement as discussed by the first commenter. Therefore, the requirement is being retained in Part 33 to provide an engine connection for AVM. Retention of the requirement does not impose a significant burden on the engine manufacturer. Accordingly, the proposal to delete § 33.29(b) is withdrawn.

Proposal 68. This amendment adds requirements for fluid injection (other than fuel) system controls under a new § 33.35(e).

A commenter suggests the proposal be changed to read: "the flow of the injected fluid is adequately controlled," and that paragraph (e) (2) be deleted. The commenter explains there exist systems which inject fluid at a fixed rate independent of power lever position. The commenter adds that some systems do not use pumps but utilize engine bleed air for pressurization and control it manually or automatically with power lever or throttle motion. The FAA agrees with the commenter, and the section is revised accordingly.

Proposal 69. This amendment to § 33.43 removes the requirement to comply with established shaft endurance stress limits when operating an engine with one cylinder not firing.

The single commenter concurs with the intent of this proposal but requests that shaft critical speeds for the cylinder-out condition be included in the operating instructions. The FAA considers that testing done under this section will provide safe operating information, including critical speeds, which must appear in the engine operating instructions in accordance with § 33.5. The proposed amendment is adopted without change.

Proposal 70. No comments were received on the proposal to correct a typographical error in § 33.49, and it is adopted without change.

Proposal 71. No unfavorable comment was received on the proposal to amend § 33.63 by deleting the word "normal," which tended to unduly restrict the operating range of rotational speeds when considering vibratory force and stress on engine and structure. The proposal is adopted without change.

Proposal 72. This proposed change to § 33.65 is based on a similar proposal deferred from Notice 75-31 (40 FR 29410; July 11, 1975) and was introduced into the NPRM after the Aircraft Engine Regulatory Review Conference held in January 1978.

The stated objective of this proposed change is to allow flightcrews to completely avoid surge and stall conditions severe enough to cause engine malfunction or damage.

One commenter agrees with the proposal with no amplifying statements. Another commenter, a rotorcraft manufacturer, expects this proposal would supply urgently needed quantitative operating margins. Considering the installation effects of rotorcraft applications, the FAA does not believe this proposal will alleviate the rotorcraft manufacturers' requirements for in-flight investigation of stall and surge characteristics (§§ 27.939 and 29.939).

The combined comments from the other respondents can be summarized as follows:

(1) The objective of the proposed change is commendable; however,

(2) Technology or state-of-the-art does not allow attainment of the objective as stated;

(3) The magnitude of testing, just in terms of variables that would need to be investigated, would be formidable and costly with little or no accompanying increase in safety;

(4) The FAA has not established documentation to justify such a rule change;

(5) An appropriate advisory circular should be issued and coordinated with industry prior to changes to this regulation;

(6) Terms such as "severity of the surge and stall" are ambiguous and unamenable to quantitative testing; and

(7) The current regulation adequately provides the desired information.

At this time, the FAA concurs with the first six items above. It further concurs that item (5) may be the first approach to correcting any FAA disagreement with item (7).

As stated under the "Explanation" of the proposed rule, the current rule is objected to for not being able to define an acceptable or rejectable degree of compliance. After further review, it is concluded that this same objection might apply to the proposed rule. Furthermore, the regulation as proposed will not meet the stated objective. The proposed regulation would still be subject to the interpretive process used to determine compliance during certification. Knowledgeable comments and other information received on this proposal make it doubtful that the objectives can be met at this time.

Considering the above, the FAA is at this time deleting this proposed change.

Proposal 73. This amendment to § 33.66 clarifies standards for bleed air system performance and for indication of the functioning of ice protection systems, if bleed air is used and can be controlled.

There were no dissenting comments. However, one commenter objects to the words "aircraft powerplant" in connection with the ice protection system, as the reader might confuse the engine anti-icing system with the aircraft anti-icing or ice protection system provided for the powerplant. The FAA concurs with the comment to use the word "engine" in place of "aircraft powerplant," and the proposal is modified accordingly.

Proposal 74. This amendment to § 33.67 brings engine fuel system standards into conformity with corresponding sections of the aircraft rules. It also adds new fuel control standards.

Since a large number of comments were received on the various sections of the proposed rule, the following discussion has been subdivided into segments for simplicity of discussion.

Ref § 33.67(a). Although no unfavorable comment was received on the proposal to amend § 33.67 by deleting all but the first sentence of § 33.67(a), the dropping of proposed § 33.67(d) introduces the need to restore, in § 33.67(a), the requirements for proper fuel control system functioning, adjustment, locking, and sealing. Therefore, the proposal is modified by deleting only the last sentence of § 33.67(a).

Ref § 33.67(b). A commenter states the proposed revision should specify that the fuel strainer or filter be installed ahead of the first engine fuel system component which is susceptible to restricted fuel flow due to contaminants. The commenter adds that this would assure that the complete engine fuel system is protected from fuel flow interruption due to contamination.

While there is merit to considering amending § 33.67(b), it goes beyond the scope of the present NPRM. These comments should properly be handled by a future NPRM to allow other interested persons time to submit their views. Therefore, the proposal is adopted without change.

Ref § 33.67(b) (3). No comment was received on the proposal to amend § 33.67(b) (3). Accordingly, the proposal, with respect to § 33.67(b) (3), is adopted without change.

Ref § 33.67(b) (4). A commenter suggested that the last sentence of proposed § 33.67(b) (4) be amended to read: "The applicant must provide evidence. . . ." This is intended to provide experience or alternative means, other than testing, for showing compliance. The FAA agrees that the word "demonstrate" as used in this paragraph

would mean to prove by operation of the device, which was not intended as the only acceptable method of substantiation. Therefore, the proposal is modified accordingly.

Ref § 33.67(b) (4) (ii). A commenter suggests deleting proposed § 33.67(b) (4) (ii) and replacing § 33.67(a) with the sentence: "Each fuel system must be capable of sustained operation throughout its flow and pressure range with fuel initially saturated with water at 80°F and having 0.75 cc of free water per gallon added and cooled to the most critical conditions for icing likely to be encountered in operation." The commenter adds that manufacturers should be allowed to show that the total fuel system is capable of operation under those conditions without establishing any specific design criteria such as use of heaters or additives. The commenter further states that some current successful systems use neither anti-icing additives nor fuel heaters.

Another commenter states that although it may be reasonable to accept that a fuel heater can cope with water saturated fuel, the effectiveness of anti-icing additives should be evaluated.

The commenter suggests that the second sentence of § 33.67(b) (4) (ii) be amended to read: "This requirement may be met by showing the effectiveness of specified approved fuel anti-icing additives or that the fuel system is fitted with a fuel heater which is capable of maintaining the fuel temperature at the fuel strainer or fuel inlet above 32°F (0°C) under the most critical conditions."

The FAA does not agree with the first commenter since the proposed change does not restrict the manufacturer to specific design criteria, but rather provides for recognized equivalent means of compliance.

The FAA substantially agrees with the suggestion of the second commenter which rectifies the objections raised and which editorially corrects the proposed changes. Accordingly, the second sentence of proposed § 33.67(b) (4) (ii) is revised except that the words ". . . which is capable of maintaining . . . ." are further changed to ". . . which maintains. . . ."

Ref § 33.67(b) (5). A commenter strongly supports the substance of the proposed revision to § 33.67(b) (5) to require demonstration of filter capability that is related to fuel contamination ". . . likely to be encountered in service. . . ." Another commenter suggests quantifying the degree of contamination to provide a consistent unambiguous requirement which can be applied fairly and consistently. Two commenters suggest the proposal be canceled and the present wording be retained since engine control system malfunctions due to fuel contamination are not a service problem.

Proposed § 33.67(b) (5) is clarifying; however, the rule for engine certification should not relate to ambiguous aircraft flight requirements, but rather to the time of continued satisfactory engine operation in the mode of partial filter blockage.

Also, there is merit to the comment relative to quantifying the degree of contamination; but, further research is required before such limits can be established. Accordingly, proposed § 33.67(b) (5) is revised as discussed.

Ref § 33.67(c). Two commenters suggest the proposal be changed to read: "(1) The flow of the injected fluid is adequately controlled," and one of the two commenters further suggests deletion of (2). The commenters explain there exist systems which inject fluid at a fixed rate independent of power lever position. The second commenter adds that some systems do not use pumps but use engine bleed air for pressurization and control it manually or automatically with power lever or throttle motion. A third commenter suggests that the flow of injected fluid must be controlled in relation to the design requirements of the engine since power produced by an engine can be influenced by a number of factors. The FAA agrees with the commenters and has revised the section accordingly.

Ref § 33.67(d). A commenter suggests that the proposal should provide for consideration of electric/electronic components which have a documented satisfactory service history. Two commenters state that it seems unnecessary to apply the proposed rule to other than full-authority control systems with electrical or electronic input.

Ref § 33.67(d) (1). One commenter suggests deletion of this section of the proposed rule on the basis that definition of reliability level would be subjective. Two commenters state that a comparative reliability level should not be imposed, the first since it was never required of hydromechanical units and the second since a comparable hydromechanical control for a given engine type may not exist. One of the commenters suggests that electronic control system reliability should be based on in-flight shutdown rate. The same commenter questions the meaning of ". . . combined level."

Another commenter states that adequacy of the secondary systems in controlling the engine for continued flight can only be determined by evaluation on the specific aircraft in conjunction with minimum crew requirements. It is noted that the requirement for continued safe operation of the installed engine after failure or malfunction is addressed in §§ 23.903, 25.903, and 29.903. However, the FAA agrees that the proposed wording is not completely consistent with engine certification requirements.

Another commenter submits a counterproposal which it is claimed will permit control functions not historically available with hydromechanical controls and will allow dispatch of an airplane with one channel of a dual system inoperative.

Another commenter supports the substance of the proposal and suggests the requirement be extended to other components susceptible to external electromagnetic interferences. The FAA agrees that the rule should be so extended; however, since the suggestion is beyond the scope of this review, the commenter is invited to submit it in proposal form for future consideration.

Ref § 33.67(d) (2). Two commenters suggest revising proposed § 33.67(d) (2) to read "Provide a means to monitor the operational status of each function critical for safe engine operation." Another commenter states it is not clear how monitoring the operational status can assure redundancy. The commenter adds that the designer should be permitted to establish compliance in a manner best suited to his particular design.

Ref § 33.67(d) (3). One commenter suggests that the term "independent power source" be clarified to more clearly state the intent. Two commenters suggest the proposal be revised since it is unnecessary to have an independent power source on the engine where a backup hydromechanical control is used in the event of power supply failure.

Ref § 33.67(d) (4). A commenter states that the proposal is too specific and that the engine manufacturer should be permitted to establish the power supply and environmental condition characteristics, including lightning or other electromagnetic interference, in which the control system will satisfactorily operate.

The scope of comments to § 33.67(d) has been extensive and raised several valid points and suggestions. Due to the extent of these comments, it is believed a major modification to this proposed change is required. Therefore, proposed § 33.67(d) is withdrawn. After reevaluation, another NPRM will be published, and the public will be given an opportunity to comment.

Proposal 75. This amendment to § 33.68 revises the requirements which govern performance under icing conditions.

A number of commenters support the proposed exemption of rotorcraft from the ground idling icing requirements, basing their justification on the unique characteristics of rotorcraft and rotorcraft operations. Others who wish to include rotorcraft under this rule point out, for instance, that oil rig operations may include lengthy loading cycles in icing conditions with rotors turning.

One commenter points out that wheel-equipped rotorcraft awaiting departure clearance can be subjected to the same delays as fixed-wing aircraft in foggy weather with temperatures conducive to induction system icing. The FAA agrees that, as a general practice, rotorcraft cannot expect preferential handling or to avoid queuing up at runways. Furthermore, the operation of a helicopter rotor system can itself, within the proposed envelope:

(1) Intensify icing conditions when ground fog or freezing drizzle under stable cloud layers is present; and

(2) Generate freezing ground fog when atmospheric conditions are close to forming natural freezing fog.

Other commenters contend that no rotorcraft have been certificated for intentional flight in icing conditions. The FAA considers this contention somewhat irrelevant in considering ground induction icing conditions. As mentioned above, ground operation can produce induction system icing without the existence of conditions conducive to in-flight icing as defined in Appendix C of Part 25 of the FAR.

Considering the above, and after further review, the FAA sees no justification for excluding rotorcraft from § 33.68(b) and has revised the proposal accordingly.

It also is suggested that a certification time of less than the 30-minute idle specified in the proposed amendment could be applied to rotorcraft engines. This suggestion may have merit, but it is believed that additional operating data are required to support a lower test time. This question will be considered in future rulemaking.

Concerning the envelope to use for testing, one commenter suggests using more general terms to describe the icing envelope, while another suggests adoption of a somewhat more severe military specification.

As was presented during the Aircraft Engine Regulatory Review Conference, recorded meteorological data, from the most severe ground icing experience during civil operation, does not support more stringent criteria. Therefore, the FAA does not agree with the proposal to adopt the military specifications.

In response to the comment to state the requirements in broad terms, the proposed regulation as stated presents minimum atmospheric parameters for all engines to meet. A lack of specific requirements could lead to a generation of engines all meeting different atmospheric conditions. This would not lead to uniformity in the certification process.

One comment was received opposed to allowing periodic engine run-up to shed ice. The comment was based on the possibility of icy taxiways and run-up pads making this procedure risky. The FAA agrees that this comment has merit under certain conditions. However, there are installations where this procedure could be perfectly acceptable under adverse ground conditions. Rotorcraft operation is one such application. The relaxatory nature of this part of the regulation need not be denied applications where safety is not compromised. It should be noted that the manner of this procedure may be controlled by limitations in the engine data sheet and/or operating instructions if appropriate. It is envisioned that run-up power excursions that are excessive or operationally untenable will be disallowed.

Therefore, with the exception of the change to § 33.68(b) discussed earlier, the proposal is adopted without change.

Proposal 76. This amendment to § 33.71 revises the standards for engine lubrication systems and makes them consistent with proposed §§ 23.1019 and 23.1021 and corresponding changes to Parts 25, 27, and 29.

A commenter disagrees with the proposal to delete the requirement for a strainer or filter ahead of each scavenge pump, stating that protecting the scavenge pump is essential to safe operation. The commenter adds that the rule already allows the applicant to size the strainer as needed to protect the pump. The FAA believes that design flexibility should be carried even further and that the need for a scavenge strainer/filter and its sizing should be determined by the engine designer.

Another commenter suggests that § 33.71(b) be further amended to read: "There must be an oil strainer or oil filter, other than at the oil tank outlet, through which all of the engine oil flows." However, this change would not provide additional clarity and would add an unnecessary restriction.

A commenter suggests that § 33.71(c)(5) be amended or deleted to permit marking the word "oil" on adjacent cowlings instead of the engine oil tank oil filler and that the

corresponding aircraft rule be amended to conform. Sections 23.1557, 25.1557, 27.1557, and 29.1557 already specify exterior markings as suggested by the commenter. The proposed oil tank filler marking drops the capacity requirement from the current rule but retains the "oil" marking in the interest of safety.

A commenter suggests that proposed § 33.71(c) (12) (ii) call for provision of makeup oil equivalent to that expected to leak from a deteriorated engine. The FAA believes that this requirement is implicit in the proposed rule and would have to be met by airworthy engines under §§ 33.19 and 33.75.

A commenter suggests that proposed § 33.71(f) be deleted because loss of lubrication during "negative g" operation has not been a problem in commercial service. Another commenter suggests deleting the reference to § 25.333 in this section since engines for general aviation fixed-wing and rotary-wing applications do not necessarily comply with it. The commenter further suggests that the amendment require the applicant to define the maximum applied loads as in § 33.23 for mounting attachments. The FAA has no records to indicate the extent of the problem with engine lubrication during negative g operation, and it is correctly noted that a Part 25 requirement should not be imposed on an engine not intended for Part 25 application. The present regulations covering lubrication system design for both reciprocating and turbine engines have been found adequate. The proposed new paragraph (f) is withdrawn as recommended, and the remainder of the proposal is adopted without change.

Proposal 77. This amendment adds a new § 33.74 which defines thrust or power augmentation systems for transport category airplanes.

After further consideration, the FAA has found it to be impractical for an engine manufacturer to comply with § 25.945 as referenced in the new section since this paragraph requires detailed knowledge of the aircraft engine installation, aircraft flight envelope, and power augmentation system hardware supplied by the manufacturer for each aircraft type. This information is seldom available to the engine manufacturer at the time of engine certification. The proposed amendment therefore is withdrawn.

Proposal 78. Two commenters object to the word "hazardous" as proposed for § 33.75, which amplifies and redefines burst limits and corrects a reference to allowable loads in amended § 33.23. They submit that an engine manufacturer is not in a position to judge what is hazardous at the time of engine certification. The commenters recommend using "release of fragments having significant residual energy" as the burst criterion.

The FAA disagrees. Released fragments are important because they may represent a hazard to the aircraft. The hazard may be related to residual energy, but even fragments which have a low residual energy may constitute a hazard. Judgment must be used under either definition by the manufacturer and the FAA during certification to determine what is hazardous. Section 33.75(b), therefore, except for the descriptive parenthetical statement, is adopted as proposed. Reference to § 33.23(b) (2) in proposed paragraph (c) is corrected by substituting § 33.23(a).

Proposal 79. This amendment adds a new § 33.76, which applies the standards of § 25.933, airplane reversing systems, to engine airworthiness.

Two commenters object to the proposed amendment on the grounds that compliance requires an evaluation of the system thrust reverser as a part of a particular aircraft reversing system. The engine manufacturer cannot anticipate or have available the aircraft design and performance data necessary to comply with § 25.933(a) and (b). The FAA agrees, and this proposal is withdrawn.

Proposal 80. This amendment to § 33.77 updates the engine foreign object ingestion requirements. For comments on the amendment to § 33.77(a) (2) and (a) (3), see the proposals for § 33.75(b) and (c), respectively.

A commenter expresses the opinion that ingestion tests should be conducted with simulated engine installation hardware and gearbox loading. The FAA finds merit in these comments but considers the suggested changes beyond the scope of the NPRM. The FAA will review these suggestions for future rulemaking action.

A commenter questions whether an engine running for 5 minutes following the bird ingestion event is adequate. In the absence of an obviously dangerous condition, however, the 5-minute run time is sufficient to demonstrate engine integrity. This commenter also suggests that in addition to the other requirements, any potentially hazardous physical damage following the bird test be considered a failure. The FAA has made this a practice in the past, and the section is changed accordingly.

A commenter submits information from an actual aircraft accident which suggests that bird ingestion certification requirements should be made stricter. The accident cited involved an engine certificated before the current requirements were adopted at a time when less demanding tests were the rule, so that the commenter's remarks may not be currently relevant. The FAA is continually reviewing bird ingestion incident data in terms of possible rulemaking action.

A commenter objects to deletion of the sand and gravel ingestion requirement, stating that the absence of sand/gravel ingestion problems in service is due to the presence of the requirement in the current rule. The commenter points out that in addition to blade erosion, adverse effects on engine seals, bleed ports, and oil sumps may lead to in-flight operating abnormalities. Although it is recognized that sand and gravel ingestion may adversely affect various turbine engine mechanisms, service experience has shown that ingestion of these materials does not possess the potential for causing sudden loss of engine power as does other ingested matter. On this basis, the requirement is withdrawn.

A commenter points out that the specified 4 percent water to air ratio is less than that which may be encountered in the atmosphere and also suggests conducting water ingestion tests at altitude conditions. The FAA agrees that in some severe rain conditions, the water to air ratio exceeds 4 percent but considers that such occurrences represent an environmental extreme rarely encountered in service. Incorporating an increased water-to-air ratio or imposing altitude conditions on the water ingestion requirements are beyond the scope of this review. The FAA will continue to review ingestion test requirements for possible rulemaking action in the future.

Several commenters question the requirement to maintain a 4 percent water-to-air ratio during acceleration and deceleration of the engine. Two of these commenters also question how evaporative effects are to be accounted for in the water-to-air ratio. It is suggested that the wording of § 33.77(c) be changed to "while ingesting water following stabilized operation. . . ." The FAA intends that the 4 percent water-to-air ratio be maintained during transients to simulate actual conditions. It is not expected that this ratio will be maintained exactly but that a minimum of 4 percent water-to-air ratio will be used during transients. The practicality of such testing has been demonstrated.

The goal of water ingestion tests is to simulate flight in heavy rain in which saturation of the air is assumed. If the engine air available during the certification test is not saturated, additional water must be added to ensure a 4 percent liquid water-to-air-ratio at the engine inlet. The proposal for § 33.77(c) is changed to clarify this intent.

A commenter recommends that § 33.77(d) be further amended to require protection from pieces of objects which, although unable to pass through the protective device when whole, may break apart upon striking the protective device and enter the engine. This protection is already provided under proposed § 33.77(d) since it does not exempt from demonstration foreign objects of a size which will pass through the protective device.

Two commenters recommend further amending § 33.77(d) (3) to read ". . . sustained reduction in power or thrust greater than those values required by paragraphs 33.77(b) and (c)." The FAA agrees. The intent is not to require greater thrust recovery for engines with protective devices than for those without them. The proposed rule is changed as recommended.

One commenter disagrees with the wording of § 33.77(e) under ice test quantity. The words "typical inlet cowl" are intended to mean an inlet cowl typical of an installation of the engine being tested. The "slab of ice" is intended to be of a size and weight which provides a test of at least equal severity to the inlet cowl and engine face ice accumulation. The meaning of these phrases is clear, and the proposed wording is adopted.

One commenter objects to the proposed distinction in § 33.77(e) between engines with inlet guide vanes and engines without inlet guide vanes in the 4-pound bird ingestion test conditions. The commenter states that service records do not justify such a distinction and that bird ingestion is an environmental condition not related to fan/inlet design. However, there is reason to distinguish between turbine engines with and without inlet guide vanes in order to test each design under its most critical bird ingestion condition. This does not imply a difference in environment but is believed to provide the best test for each design type. FAA report No. FAA-RD-77-55, "Improved Resistance to Engine Bird Ingestion," dated March 1977, indicates that rotating blade damage is inversely proportional to the entering velocity of the bird due to the addition of the bird velocity vector and the blade velocity vector. An engine with inlet guide vanes is likely to be struck on a vane rather than a blade, and the vane damage will increase with increasing bird velocity. The proposed wording is retained. The FAA will continue to study the bird ingestion hazard.

Proposal 81. This amendment to § 33.83 broadens the vibration test requirements and affords added flexibility to the test methods.

Two commenters suggest that the title be changed in order to better describe the purpose of the test and avoid confusion with §§ 33.33 and 33.63. The FAA disagrees. Section 33.33 is a requirement for the design of reciprocating engines, § 33.63 is a similar requirement for design and construction of turbine aircraft engines, while § 33.83 relates to the block testing of aircraft turbine engines. Section 33.63 is a design consideration for turbine engines, whereas § 33.83 is a substantiation means.

Two commenters object to the use of the term "maximum permissible takeoff speed" since takeoff speed may not be the maximum permissible speed for certain engines. The FAA agrees, and the word "takeoff" is deleted from the first sentence of § 33.83(a).

Three commenters object to the wording of § 33.83(b) concerning acceptable methods for showing compliance. One commenter suggests that stress margins which are appropriate to the components being evaluated be recognized, while the others maintain that compliance can be shown by engine test as well as by analysis. The FAA agrees with both comments but believes the proposed wording is adequate. Each method of showing compliance with this section during the certification process is reviewed by the FAA.

Another commenter suggests insertion of the word "hazardous" before "failure" in § 33.83(a). The commenter points out that there could be minor failures during this test. The FAA considers that all failures should be evaluated in terms of each engine design, as the distinction between minor and hazardous conditions cannot always be pre-established for a new design.

A commenter suggests that some clarification of the term "loading device" would be of assistance. As used in this regulation, the term "loading device" (i.e., dynamometer) applies primarily to turboshaft and turboprop engines. Turbofan and turbojet engines are not usually loaded externally during the endurance test. The intent of this regulation is to assure that the turboshaft and turboprop engines are loaded in the same manner as during the endurance test.

The amendment to § 33.83 is adopted as proposed except for the change described.

Proposal 82. This amendment to § 33.87 clarifies the 150-hour endurance test procedure, provides alternative means of compliance, and adjusts the test schedule for helicopters.

One commenter questions the validity of conducting the endurance test of an accessory drive and mounting attachment on a separate rig, as provided by proposed § 33.87(a)(6). The commenter suggests that rig testing be supplemented by running the accessories on an engine. The FAA has found that when properly conducted, the gearbox rig tests with accessory loading provide sufficient data for endurance certification. In addition, such tests are often a more practical solution to the problem of environmental control and data collection encountered during endurance engine running. The accessory weights and overhung moments must be simulated during full engine testing, but power extraction effects may be substantiated by rig test.

A commenter suggests eliminating operation at rated 2½-minute power during the third and sixth takeoff power periods for one of the twenty-five 1-hour sequences specified by current § 33.87(d) (1). The commenter argues that proposed § 33.87(d) (2) increases the cumulative endurance test time at the 2½-minute power condition and that the increase should be compensated for in § 33.87(d) (1). The FAA does not agree. One reason for including proposed § 33.87(d) (2) is to establish a margin of safety for the 2½-minute power rating. Compensating for the increased time at 2½-minute power would cancel, to some extent, the intent of this proposal. The FAA recognizes that the total time required at 2½-minute power will be increased by 5 minutes but does not consider this increase to be significantly burdensome. However, the wording of proposed § 33.87(d) (2) is revised to make it clear that the 5-minute test at 2½-minute power is to be included within, rather than in addition to, the 30-minute test period.

One commenter requests that an "Emergency Power Rating" (EPR) be established for rotorcraft. The EPR would be a power greater than 2½-minute power and used for one engine inoperative takeoff in multiengine rotorcraft. The EPR would be permitted for up to a 30-second duration. The commenter proposes that the 30-second EPR be included in the 150-hour endurance test in this section. The FAA finds that although this proposal has merit, it is beyond the scope of the Engine Review. Therefore, the amendment to § 33.87 is adopted as proposed except for the changes described.

Proposal 83. This amendment to § 33.88 relieves the overtemperature test requirements by reflecting actual conditions more realistically.

One commenter recommends less reduction in test time than that proposed and suggests that such a reduction be made based on analysis of service experience that shows this to be acceptable. The commenter also recommends that the second sentence be revised to state that the turbine assembly be within dimensional limits established for allowing it to remain in continued service.

The FAA does not agree that the time reduction is drastic since engines certified before Amendment 33–6 were in fact tested for the 5-minute condition. Service experience with these engines, with regard to overtemperature capability is excellent. Additionally, all post-Amendment 33–5 certified engines have been granted exemptions from the existing 30-minute requirement and were tested for 5 minutes as is now proposed. The dimensional limits quoted in the proposal are in fact service limits as suggested by the commenter, which are determined during the certification process. Therefore, the FAA finds further clarification to be redundant.

Another commenter objects that the engine overtemperature test requirements inherently involve blade creep life, which is considered an economic item rather than an airworthiness item. The commenter states that the true need is to evaluate rotor disc integrity under conditions of possible overtemperature due to disc cooling system failure which might result in temperatures higher than the specified 75°F above maximum rated. The FAA position is that the regulation will ensure that the turbine assembly can satisfactorily withstand an overtemperature of 75°F above the maximum operating temperature for a period of time consistent with what could reasonably be expected in service. The test is designed to evaluate gross effects of a 5-minute overtemperature condition on the engine turbine assembly, which includes blades, discs, drums, spacers, shafts, seals, stators, nozzles, and support structure. Therefore, § 33.88 is adopted as proposed.

Proposal 84. This amendment to § 33.89 broadens the operational test requirements by calling for testing, if necessary, throughout the operating envelope of the engine.

A commenter complains that the tests do not demonstrate that rapid throttle movement does not constitute an operational hazard. It should be noted that § 33.89(a), through reference to § 33.73, requires demonstrating rapid throttle movement from minimum to maximum position. This commenter also considers it unreasonable to expect flight crewmembers to monitor engine controls during emergency conditions. The FAA, on the contrary, considers it reasonable to expect pilot monitoring and appropriate

manipulation of engine controls within the context of the operational situations addressed by this comment.

One commenter objects that the proposed change has the same meaning as the current regulation while being less explicit. However, the proposed amendment contains all of the previous considerations implicitly within the new wording and at the same time has been expanded to include the entire operating envelope of the engine. Accordingly, the proposed rule is adopted without change.

Proposal 85. This amendment to § 33.90 discontinues use of the word "overhaul" and recognizes the validity of alternative maintenance programs.

One commenter suggests that the rule approve the process of reconditioning after test and inspection if it is determined that such process is required. The FAA agrees that if the test results show that maintenance action is required, it should be so specified. Another commenter suggests that substituting "initial maintenance inspection" for "overhaul test" merely replaces one contentious phrase with another and urges that § 33.90 be deleted as being unnecessary to safety. The FAA does not agree since not all Part 33 turbine engines come under the regimen of a structured reliability program. Recent experience with two new engine certification programs under current rules has shown the need for an initial inspection interval of certain hot section components. Significant deterioration of engine operating and performance characteristics would exist without the specified inspection and repair requirements. Accordingly, the proposed amendment is adopted with the change noted above.

Proposal 86. This amendment to § 33.92 deletes the windmilling test requirement for subsonic turbine engines and amplifies the rotor burst and load limitations as in the proposal for § 33.75(b).

In addition to comments previously discussed for § 33.75, two commenters question deleting the windmilling test requirement for subsonic engines. The commenters suggest that existence of the current requirement may account for the lack of service problems associated with windmilling engines. The FAA disagrees. Most engines currently in service have a certification basis which predates the windmilling test requirement of § 33.92 but, nevertheless, have accumulated years of service with no reported incidents of windmilling hazards. It has not been demonstrated that an engine test of windmilling capability is required for all subsonic engines.

One commenter recommends adding a requirement that the applicant provide evidence to show that the engine windmilling without lubricating oil would not result in a condition which would jeopardize the aircraft. The FAA agrees but believes that § 33.75 provides this assurance. Proposed § 33.92 therefore is adopted with the addition of the reference to mount load limits as proposed for § 33.75.

Proposal 87. No comment was received on the proposal to amend § 33.93(b) by substituting the word "part" for "component" to preclude ambiguity, and the proposal is adopted without change.

Proposal 88. This amendment provides a new § 33.94 which adds blade failure containment testing of engines for certification.

Several commenters object to the requirement of § 33.94(a) that the engine run for at least 15 seconds before initiating shutdown after the event, claiming that it is unduly restrictive. They state that an engine which shuts down in less than 15 seconds would be acceptable, provided it does not burst, catch fire, or generate excessive mount loads. The same commenters propose that § 33.94(a) (1) be changed to permit use of component rig containment tests to supplement the engine test whenever facility limitations prevent attaining maximum permissible speed on a complete engine.

The FAA agrees that certain engines may not be able to operate for 15 seconds after the failure event. Accordingly, § 33.94(a) is modified to allow for instances where the resulting damage prevents the engine running for the required 15 seconds.

The FAA agrees that rig tests are valid, as reflected in proposed § 33.94(b), and in fact manufacturers' rig tests are being used to supplement complete engine blade containment

tests for certification purposes. It is concluded, however, that such determinations will be made on a case-by-case basis under the authority provided by proposed § 33.94(b).

Another commenter suggests that § 33.94(a) (2) should be changed so that the engine test is based on the most critical engine casing temperature rather than the most critical turbine blade. Analysis leading to determining the most critically operating turbine blade would be expected to include analysis of case material properties at critical temperatures in an engine operating at maximum permissible r.p.m. Therefore, additional clarification is not considered necessary, and the amendment to paragraph (a) (2) is adopted as proposed.

REGULATORY EVALUATION

The FAA conducted a detailed regulatory evaluation which is included in the regulatory docket. Based on a review of available FAA data, cost data supplied by the Aerospace Industries Association (AIA) and the General Aviation Manufacturers Association (GAMA), and data from the National Transportation Safety Board (NTSB) accident data file, FAA determined that this overall rule provides cost savings that substantially outweigh the additional costs imposed on society.

The amendments in this final rule provide benefits in the aggregate to the aviation public, most specifically to airframe and engine manufacturers. These amendments provide general benefits by deleting obsolete requirements and clarifying the text, by updating and modernizing technical requirements to reflect engineering advances in the state-of-the-art, by reflecting the changing interface between the airframe and engine manufacturers, and by taking into account FAA accumulated service experience. This rule imposes no costs on the Federal Government.

Industry estimates of costs and benefits provided to the FAA for specific amendments were aggregate undiscounted 10-year estimates stated in 1981 dollars. The FAA was unable to break down these aggregate estimates into annual estimates because of the uncertainty of the number of new type certificated engines and aircraft models in a given year as well as the subsequent production of these engines and aircraft in a given year. Furthermore, industry was unwilling to supply information pertaining to the number of companies impacted by each of these amendments, or specific information on the number of estimated new type certificated engines and aircraft in a given year as well as subsequent production estimates, for reasons of individual company confidentiality.

Since it was assumed the Aircraft Engine Regulatory Review initiative would become final rule in 1983, the FAA adjusted the cost estimates to 1983 dollar values and then discounted these values for the years 1984 and 1992 to arrive at a range of values for the 10-year period of 1983–1992. The FAA did this because it was not known in which of these years the costs and benefits associated with the proposals would occur; therefore, by discounting the values in 1984 (assuming all benefits and costs occur in this year would result in the highest possible discounted values) and in 1992 (assuming all benefits and costs occur in this year would result in the lowest possible discounted values), a representative range is developed. The discount rate for 1984 is 0.91 and the discount rate for 1992 is 0.38. This range was conducted for all beneficial or cost imposing proposals except § 23.903(b) where FAA was able to obtain more refined data.

Major Benefits—Regulatory amendments that are expected to yield major benefits are summarized below (first-order discounted cost savings are stated in 1983 dollars and represent the range of savings for the *10-year period* of CY 1983 through CY 1992):

1. Section 23.903—The proposal allows the use of satisfactory foreign object ingestion (FOI) service experience for turbine engines as an alternate to meeting § 33.77 in effect on October 31, 1974, or as subsequently amended, to be eligible for installation. Currently, an airframe manufacturer would have to conduct FOI tests on any inservice turbine engine that is installed on a new airplane even though the engine may have a satisfactory FOI service experience. Estimated discounted test cost savings from eliminating this requirement in terms of 1983 dollars are $2.11 to $5.05 million for the period of CY

1983–1992. Considerable cost could be imposed on airframe manufacturers that choose to install engines certified to Part 33 FOI requirements prior to October 31, 1974, on future type certificated airplanes that have a bad FOI service experience. FAA considers that those instances would be rare from a technological state-of-the-art standpoint.

2. Section 33.14—This proposal provides engine manufacturers with more latitude in the type of procedures they can use for establishing low-cycle fatigue service lives for rotating components and for increasing these lives. This proposal also increases the applicability of the rule, redefines the term "start-stop stress cycle," and permits an alternative to parts temperature stabilization if justified. The current rule is unduly restrictive, because it prescribes only a fixed reduction factor for determining the initial service life and only one method for increasing these lives based on testing of parts removed from service. Estimated discounted test cost savings in terms of 1983 dollars are $16.15 to $38.69 million for the period of CY 1983–1992.

3. Section 33.68—This proposal relaxes the 30-minute idle with freezing fog requirement test criteria, permits periodic engine runups, and permits temperature variation, all with regard to induction system icing. The current test requirement is unnecessarily severe because it is outside the maximum icing envelope of Appendix C of Part 25, and because no tolerances are permitted on the temperature and liquid water content. Program and production cost savings will be achieved through reduced anti-icing system hardware and installation costs and through simplification of the engine design and manufacturing process. Specifically, this amendment eliminates in almost all cases the design and installation of components for a supplementary heating system. Estimated discounted savings in terms of 1983 dollars are $214.02 to $517.17 million for the period of CY 1983–1992.

4. Section 33.71—This amendment deletes the requirement for scavenge oil strainers and marking oil tank filler capacity. Service experience shows that scavenge oil strainers do not necessarily improve safety but do tend to restrict design of the oil system. There is no safety need to mark tank capacity on the oil tank filler. Estimated discounted component, installation, and labor cost savings in terms of 1983 dollars are $2.11 to $5.05 million for the period of CY 1983–1992.

5. Section 33.77—This proposal eliminates the tire, sand, and gravel FOI test requirements. The tire test requirement is deleted because service experience has shown that hazardous consequences from ingestion of a piece of tire are no greater than those associated with ingestion of a 4-pound bird. Furthermore, service experience has shown that ingestion of sand and gravel does not possess the potential for causing sudden loss of engine power as does other ingested matter. Eliminating these requirements will result in some test cost savings and reduced hardware (engine) burnup. Estimated discounted test cost savings in terms of 1983 dollars are $9.62 to $23.02 million for the period of CY 1983–1992.

6. Section 33.83—This proposal allows the use in certain cases of a modified version of the endurance test loading configuration for the required vibration survey which would enable the use of a modified configuration if that loading device is incompatible with the necessary vibration instrumentation. The current regulation is unduly restrictive because it requires that the vibration survey must be conducted using the same configuration of the loading device which is used for the endurance test. A comparable test on the engine will serve the same results. Estimated discounted labor cost savings in terms of 1983 dollars are $4.18 to $10.01 million for the period of CY 1983–1992.

7. Section 33.87—This section allows separate, more convenient rig testing of accessory drives and mounting attachments. The FAA has found that gearbox rig tests with accessory loading provide comparable data to endurance certification tests. The current regulation requires that load testing of accessory drives and mounting attachments must be performed on the engine. The FAA has found this to be too stringent a requirement. There will be possible small cost savings in equipment to operate the accessory drive. Estimated discounted cost savings in terms of 1983 dollars are $1.17 to $2.80 million for the period of CY 1983–1992.

8. Section 33.88—This proposal reduces the duration of the overtemperature test from 30 minutes to 5 minutes. The current rule has been found unnecessarily severe since service experience has shown that none of the turbine engines subjected to 5-minute overtemperature tests have experienced inservice rotor disc primary failure due to overtemperature. Significantly reducing the duration of the overtemperature test adequately demonstrates the integrity of rotor discs without subjecting them to unnecessarily hazardous conditions and saves development of hardware for blades, discs, drums, etc. Estimated discounted test and hardware cost savings in terms of 1983 dollars are $9.03 to $21.62 million for the period of CY 1983–1992.

9. Section 33.92—This amendment deletes the windmilling without oil test for subsonic turbine engines. There have been no reported incidents involving windmilling hazards to aircraft resulting from loss of engine oil, and it has not been demonstrated that an engine test of windmilling capability is required. Estimated discounted test cost savings in terms of 1983 dollars are $0.96 to $2.30 million for the period of CY 1983–1992.

Major Costs—Regulatory amendments that are expected to impose major costs are summarized below (first-order discounted costs are stated in 1983 dollars and represent the range (except § 23.903) of new costs imposed for the *10-year period* of CY 1983 through CY 1992):

1. Section 23.903—This amendment requires that design precautions be incorporated in Part 23 certified airplanes to protect these airplanes from uncontained rotor failure events. As the use of turbine engines on Part 23 certified airplanes increases, especially in for-hire operations, airplanes certified under Part 23 should be afforded the same level of safety from uncontained rotor failures as airplanes certified under Part 25. The FAA obtained information pertaining to two cases in the past 10 years involving uncontained rotor failures in Part 23 certified airplanes. In terms of 1983 dollars, the cost of these accidents (injuries and aircraft damage) is approximately $1.1 million based on values contained in the *Economic Values for Evaluation of FAA Investment and Regulatory Programs*. Assuming that this proposed rule would protect against all uncontained rotor failure events, $0.93 to $2.2 million is the discounted exposure adjusted benefit (cost savings) range for a 10-year period beginning CY 1983. These estimates include the projected increase in the number of hours flown by turbine-powered general aviation airplanes. It is noted in both cases that uncontained rotor failure was the secondary cause of these accidents (incidents), both of which were precipitated by worn components in the gear assemblies according to the NTSB. It is also noted that this rule is proposed in order to prevent a future problem in certain Part 23 airplanes because installation of turbine engines in these airplanes is expected to increase significantly in the next 10 years. Furthermore, a significant increase in the number of Part 23 certified turbine-powered airplanes used in air taxi and corporate operations is expected, and the FAA believes that protection comparable to that required under Part 25 is needed when carriage of passengers is involved.

This requirement places an economic burden on the manufacturers of these small airplanes. This requirement may influence future airframe design in areas such as armor protection and engine location.

In an attempt to derive cost estimates, the FAA contacted GAMA and various airframe manufacturers. Most of these organizations indicated that the proposed regulation would impose significant costs, but they were not able to provide specific estimates because of the complexity of the issues, and the amount of time it would take to compile estimates. Additionally, the extent of specific design changes to future type certificated airplanes was not immediately known.

One industry organization estimates that the cost to the manufacturer of compliance per airplane could easily reach $20,000, including increased engine price, cost of materials, design, development, testing, tooling expense, labor, and normal factory overhead. Specifically, this organization stated that the typical engine would require a containment shield (using a Kevlar fabric which is believed to be the most weight efficient installation)

and that design adjustments would be required to provide for proper cooling, assurance of cowling drainage, and access to service points. Furthermore, the organization stated that considerable engineering and flight test development would be involved in assuring that maintenance could be accomplished on the engine, and the development of ballistic confirmation tests and certification would be extensive. The FAA ascertained through discussions with industry that an estimated 10 new turbine-powered airplane models would be eligible to be certified to Part 23 standards during the next decade. Because it is not certain in what years these airplane models will be certified, the FAA assumes that one airplane will be certified each year from 1983 through 1992. Furthermore, the projected production levels for each of these models in future years is not known. Based on past production levels of certain Part 23 turbine-powered airplanes, the FAA assumes an average annual production of 75 airplanes for each newly-certified model in each year following the year of certification.

Using this assumption, 3,375 airplanes will be manufactured between 1983–1992 of models which were newly-certified to Part 23 during this period.

The following table shows that the discounted value of costs over the 10-year period of 1983–1992 in 1983 dollars of requiring design precautions to minimize rotor failure events is $37.8 million. It assumes that the cost of compliance per airplane is $20,000. These are first-order costs which are initially borne by the airframe manufacturer, and the costs do not take into account the effect of increased prices with respect to the impact on domestic sales and foreign competition implications.

Discounted Value of Costs of Proposed Rule

Year	*Airplane Production*	*Cost of Compliance per Airplane*	*Present Worth Discount*	*Discounted Value of Cost of Rule*
1983	0	$20,000	1.00	$ 0
1984	75	20,000	0.91	1,365,000
1985	150	20,000	0.83	2,490,000
1986	225	20,000	0.75	3,375,000
1987	300	20,000	0.68	4,080,000
1988	375	20,000	0.62	4,650,000
1989	450	20,000	0.56	5,040,000
1990	525	20,000	0.51	5,355,000
1991	600	20,000	0.47	5,640,000
1992	675	20,000	0.43	5,805,000
Total	3,375			$37,800,000

This rule would also impose certain second-order costs on purchasers of these airplanes in terms of increased inspection costs (removing and installing the system at each inspection interval) and decreased airplane performance due to a maximum 100-pound increase in airplane empty weight. The benefit/cost considerations may improve because increased use of turbine engines in Part 23 certified airplanes will increase the risk of rotor failure accidents.

2. Section 25.1091—This amendment requires that the FOI criteria of § 33.77 be applied to vulnerable portions of the air induction system such as inlet splitter vanes, duct-mounted instrumentation, and annular rings. Parts of the air induction system such as annular rings and splitter vanes are physically located in front of the engine. These parts were installed to reduce engine inlet noise in a limited number of airplanes. If these components are included, they should be subject to the same FOI requirements as the engine because of their possible breakoff into the engine. Most aircraft induction systems do not use splitters, etc., and therefore most aircraft engines would not be affected by this rule. This requirement was inadvertently left out of Amendment 33-6 in 1974. The estimates of the discounted cost range of improved materials and testing for these specific

Table 1[1]
Aircraft Engine Review Benefit/Cost Matrix By Major Amendment,
for the 10-Year Period of CY 1983 Through CY 1992
($ in millions)

	FAR	*Benefits*	*Costs*
23	23.903(a) (2)	$2.11–5.05	$–
	23.903(b)	0.93–2.22	37.80
	Subtotal	3.04–7.27	37.80
25	25.1091(e)	–	2.11–5.05
	Subtotal	$ 0	2.11–5.05
27	none	–	–
	Subtotal	$ 0	0
29	none	–	–
	Subtotal	$ 0	0
33	33.14	16.15– 38.69	–
	33.68	214.02– 517.17	–
	33.71(b)	2.11– 5.05	–
	33.77	48.91– 117.11[2]	1.05–2.50
	33.83(a)	4.18– 10.01	–
	33.87(a) (b)	1.17– 2.80	–
	33.88	9.03– 21.62	–
	33.92(c)	0.96– 2.30	–
	Subtotal	$296.53–714.75	$ 1.05– 2.50
	Total	$299.57–722.02	$40.96–45.35

[1] Benefit and cost values are stated in 1983 dollars.
[2] Of this amount, $39.29 million to $94.05 million is the benefit attributed to an accident caused by water ingestion.

items to meet the criteria of § 33.77 in terms of 1983 dollars are $2.11 to $5.05 million for the 10-year period of CY 1983–1992. However, the actual cost of compliance will be much lower because compliance with FOI standards may be shown by analysis as well as testing, and the FAA sees little application of such devices in the future.

3. Section 33.77—This amendment requires that a 4 percent water-to-air ratio be maintained during transients in order to simulate actual flying maneuvers in heavy rain. The current rule requires that the ratio be maintained only for takeoff and idle conditions but does not require any demonstration of the ability to accelerate or decelerate safely under water ingestion conditions. Such ability is essential for safe flight in heavy rains. The FAA obtained information pertaining to one case in the past 10 years involving turbine engine failures due to water ingestion during transients, a Southern Airways accident in 1977. The NTSB reported that the probable cause of the accident was a loss of thrust of both engines while penetrating severe thunderstorms. The NTSB also reported the accident resulted from a loss of thrust caused by ingestion of massive amounts of water and hail which, in combination with thrust lever movement, induced severe stalling in and major damage to the engine compressors.

In terms of 1983 dollars, the cost of this case (injuries and aircraft damage) based on values contained in the *Economic Values for Evaluation of FAA Investment and Regulatory Programs* is approximately $47.0 million. Assuming that this proposed rule

would protect against all accidents and incidents involving turbine engine water ingestion, $39.29 to $94.09 million is the discounted exposure adjusted benefit range (cost savings) for the period of CY 1983–1992. This estimate includes the projected increase in the number of hours flown by turbine powered aircraft.

This amendment would require engine manufacturers to conduct a more precise water ingestion test and to collect more test data to verify engine performance as it relates to water ingestion. It could require the engine manufacturer to purchase additional test equipment. The estimated additional discounted cost to the engine manufacturers to perform this test in terms of 1983 dollars is $1.05 to $2.50 million for the period of CY 1983–1992.

The first-order discounted benefit and cost ranges of these major proposals are summarized in Table 1. This table shows that the most conservative benefit/cost ratio for the entire evaluation is $299.57 to $45.35 million or 6.61 to 1.00.

ADOPTION OF AMENDMENT

Accordingly, Parts 23, 25, 27, 29, and 33 of the Federal Aviation Regulations (14 CFR Parts 23, 25, 27, 29, and 33) are amended effective March 26, 1984.

(Section 313(a), 601, and 603, Federal Aviation Act of 1958 (49 U.S.C. 1354(a), 1421, and 1423); and 49 U.S.C. 106(g) Revised, Pub. L. 97–449, January 12, 1983).

NOTE: The FAA has determined that this amendment yields overall cost benefits by eliminating unnecessarily stringent design requirements and by simplifying and clarifying existing rules without reducing the level of engine installations. The amendment simplifies a number of technical requirements and removes administrative burdens on regulated persons and the FAA through amendment of regulations from which exemptions have been granted. Therefore, it has been determined that this is not a major regulation under Executive Order 12291. In addition, the FAA has determined that this amendment is not significant under the Department of Transportation Regulatory Policies and Procedures (44 FR 11034; February 26, 1979). The evaluation prepared for this action is contained in the regulatory docket. A copy of it may be obtained by contacting the person identified under the caption "FOR FURTHER INFORMATION CONTACT."

Amendment 33-11

Airworthiness Standards: Aircraft Engines; Turboprop Engine Propeller Brake

Adopted: March 18, 1986 **Effective: April 24, 1986**

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SUMMARY: This amendment establishes new airworthiness standards applicable to turbopropeller engines equipped with a propeller brake. The brake allows the propeller to be brought to a stop while the gas generator portion of the engine remains in operation as an auxiliary power unit (APU). The amendment is needed to establish an appropriate level of safety for the certification of aircraft engines with this new feature.

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SUPPLEMENTARY INFORMATION:

BACKGROUND

A Notice of Proposed Rulemaking (NPRM), No. 84-23, was published in the FEDERAL REGISTER (49 FR 48760) on December 14, 1984. The NPRM proposed to establish new airworthiness standards applicable to the type certification of turbopropeller engines equipped with a propeller brake. Such engines feature a brake which allows the propeller to be brought to a stop while the gas generator portion of the engine remains in operation as an APU. Certification standards for such engines are not presently included in the Federal Aviation Regulations (FARs), and engine designs with this feature have, to date, been certificated through special conditions. As it is anticipated that such engine designs will continue to be submitted for airworthiness certification in the future, the FAA has determined that appropriate airworthiness standards should be established in the FARs. This amendment establishes type certification test requirements for turbopropeller engines also used as an APU. The tests are intended to provide for assessment of:

(a) Hot section tolerance for locked rotor operations effects on combustor stability/coking, turbine nozzle integrity, turbine blade integrity, vibration, etc.

(b) Engine drive system stability/response, including the power turbine rotors, shafting, bearings and supports, reduction and accessory gear trains, and rotor brake components.

Interested persons were given an opportunity to participate in the making of this amendment and due consideration has been given to all matters presented. Comments were received and are responded to herein.

DISCUSSION OF COMMENTS

Two commenters suggested that the proposed title for the new §33.96 be changed to read "Engine tests in APU mode" to emphasize that the requirement is to test the complete engine (including the propeller brake), and to emphasize that the tests are not related to propeller parking brakes to prevent windmilling. FAA agrees, and the title is changed accordingly.

Two commenters recommended that the first sentence of proposed §33.96 be revised to have the rule also apply to engine designs with "provisions" for a propeller brake. Both commenters also recommended insertion of the words "is intended to" before "remain stopped . . . " One of the two commenters further suggested that last portion of the introductory sentence be changed to allow the propeller brake tests to be performed in conjunction with the applicable endurance test schedule of §33.87, if system test parameters permit an if found appropriate by the Administrator. FAA does not agree that

the rule should address provisional engine designs. The type design of the engine to be certificated must define the configuration to be presented for inspections and tests as expressed in FAR 21, §21.31 and §21.33. In this context, there can be no "provisional" engine designs. FAA also does not agree with the suggestion concerning intent of design since the proposed rule expressly speaks to the actual type design submitted for certification. FAA agrees with the suggestion that propeller brake tests may be conducted in conjunction with required tests of §33.87. Note that this has been typical practice with FAR 33 type certification testing in the past and, where conditions permit, is expected to continue in the future. Accordingly, FAA finds it unnecessary to incorporate this by rulemaking.

One commenter suggested that the first sentence of proposed §33.96 be revised to refer to §25.1309 in addition to §33.87 to assure that the risk of inadvertent propeller brake operations, and the need for fail-safe provisions, are addressed at the aircraft level, as well as at the engine level. FAA agrees with the commenter's objectives. However, the existing airworthiness standards concerning engine installations in FAR Parts 23 and 25, are considered adequate to assure a minimum level of airworthiness for certification of installations of engines designed with propeller brakes for APU mode operations. In this case the engine manufacturer will be required to perform a safety analysis, in accordance with the existing requirements of §33.75, which addresses APU mode operations. The FAA intends that the results of this analysis will be applied as necessary to the installed engine safety analysis, at the airframe level by the airframe manufacturer, to demonstrate compliance with §25.1309 or §23.1309, as appropriate.

A commenter stated that proposed §33.96(a) is ambiguous in that the objective of the ground locking test can be met by a system which locks the propeller shaft but has no braking function; yet the requirement can be read as applying only to the brake (*i.e.*, it must function without adverse effect on itself during this test). The same commenter stated that proposed §33.96(b) is also ambiguous, in that it is unclear whether the brake must function without adverse effects while mounted on the engine, or that the engine must suffer no adverse effects when the brake is used. FAA does not agree that the proposed rule is ambiguous. The proposed rule requires that the engine propeller brake must be demonstrated to be satisfactory, and it must not adversely effect the rest of the engine while operating in the APU mode.

Two commenters suggested that the engine operating conditions which apply in §33.96(b) be revised to read ". . . , as specified by the applicant." FAA agrees with the commenters and the proposed rule is changed accordingly.

A commenter suggested that the proposal for §33.96(c) is too restrictive in that the actual brake to be used may not be available at the time of the test for designs where provision is made for an optional propeller brake. As discussed earlier, the type design of the engine to be certificated must define the configuration to be presented for inspections and tests. In this context, there can be not provisional engine designs.

A commenter proposed to add a new §33.96(d) to clearly identify the need to conduct all propeller brake testing on the same engine, but not necessarily the engine used for the endurance testing. FAA concurs with the commenter and the proposed rule is changed accordingly.

A commenter suggested that propeller brake equipped engines will require additional evaluation to the following sections of FAR 33: §§33.14, 33.19, 33.21, 33.63, 33.75 and 33.90. FAA agrees with the concerns expressed by the commenter. However, further rule change is not necessary since the existing rules are sufficiently comprehensive to include engine APU mode design and test operations. The commenter also suggested that design and construction paragraphs 6.13, 6.14, 6.15 and 6.16 of FAA Technical Standard Order (TSO) -C77a (gas turbine auxiliary power units) should be reviewed for applicability to a propulsion engine used as an APU. These paragraphs concern automatic features for temperature control, speed and acceleration control, safety devices, and automatic shutdown features, respectively. The commenter's concern was that if engine operation without a qualified pilot monitoring engine performance is expected, the automatic

monitoring devices and shutdown features required for APU's should be incorporated. FAA considers the existing airworthiness rules of FAR 33 to be adequate with regard to basic operations and control of the engine as an APU. If a manufacturer elects to incorporate such features in the engine design, then that configuration will be evaluated against each of the FAR requirements. In any case, appropriate operating limitations, including minimum crew requirements for APU mode operations, will have been established as part of the type certification of the engine and/or the aircraft. The commenter further stated that while disassembly inspection is required for the §33.96(c) test, it is not clear that such an inspection would be required for the tests listed in §§33.96(a) and (b). FAA agrees with the commenter. To preclude any misunderstanding, that sentence of the proposed rule is restructured as a separate section and the tests required by subsections (a), (b) and (c) are specifically indentified therein.

A commenter proposed that the rule defined the engine configuraton to be used for testing. FAA agrees with the substance of the comment; however, further rule change is unnecessary since §21.33 and §21.53 adequately address this concern. The commenter further proposed to require design substantiation submittals in accordance with existing §§33.15 through 33.27, 33.62, 33.63, and 33.75. FAA agrees but, as discussed in the previous comments, further rule change is considered unnecessary. The commenter also suggested that FARs 23, 25, 27, and 29 may need review to ensure that adequate indication is provided and that controls are located and configured so as to make inadvertent operation unlikely. FAA agrees with the commenter's objectives, but further rule change is considered unnecessary since the existing certification rules covering turboprop engine installations are considered adequate in this regard.

REGULATORY EVALUATION

The FAA has determined that the benefits of this rule, while difficult to quantify, outweigh the minimal costs incurred in the certification of a propeller brake. The FAA realizes that the risk of inadvertent operation of the propeller brake or other related malfunction could have catastrophic consequences and, therefore, testing is required to make certain that the propeller brake is safe. Because manufacturers would test the propeller brake even if there were no federal regulation mandating such testing, the cost impact of the regulation will be minimal. The only additional costs would be those attendant to the certification process. Even though manufacturers are likely to test the brake on their own initiative, the regulation is required to ensure that the testing to established minimum standards has, in fact, been uniformly and satisfactorily completed.

The benefits of the regulation are difficult to quantify because industry would likely test the propeller brake even without the regulation. However, the regulation is required to ensure that the propeller brake is safe. Without this assurance the propeller brake's safety is open to question. Safety benefits are derived from the prevention of any possible catastrophic failures.

Other benefits which are difficult to quantify occur because the propeller brake allows the engine to remain on while the propeller is stopped. This will enable the engine to provide auxiliary power to the aircraft without the necessity of a ground power unit, thus allowing more flexibility in operations. It will also save time in turning around an aircraft because a ground auxiliary power unit will not be needed. The overall benefits outweigh the overall costs because the costs are minimal and there are benefits, although unquantifiable, in the prevention of a catastrophe, along with other operational minimal benefits. There were no comments relating to the economic aspects of this rule.

The Regulatory Evaluation which has been placed in the docket contains additional detail relating to costs and benefits, and Trade Impact Assessment and the Final Regulatory Flexibility Determination.

TRADE IMPACT

The FAA has determined that there will be no impact on international trade as a result of the rule. Since certification rules are applicable to both U.S. and foreign manufacturers that sell in U.S., there will be no competitive advantage to either. Because the test

requirements are good commercial practice, foreign manufacturers are expected to certificate to similar standards as exist in the U.S. Therefore, U.S. manufacturers will not be at a disadvantage in foreign markets. There were no comments relating to Trade Impact.

REGULATORY FLEXIBILITY DETERMINATION

The Regulatory Flexibility Act of 1980 (RFA) was enacted by Congress to ensure that agencies shall endeavor to fit regulatory requirements to the scale of the entities subject to regulations. The RFA requires agencies to review proposed rules which may have "a significant economic impact on a substantial number of small entities." In the case of aircraft engine manufacturers a small entity is one with 375 or fewer employees. Eight firms in the U.S. manufacture turbine aircraft engines, none of which have fewer then 375 employees. Therefore, the FAA certifies that this rule does not impact a substantial number of small entities. There were no comments relating to the Initial Regulatory Determination.

CONCLUSION

The FAA has determined that this document involves a regulation which is considered to be not major under Executive Order 12291, or significant under DOT Regulatory Policies and Procedures (44 FR 1134; February 26, 1979), and certifies that if promulated, it will not have a significant economic impact on a substantial number of small entities under the criteria of the Regulatory Flexibility Act.

ADOPTION OF AMENDMENT

Accordingly, the Federal Aviation Administration amends Part 33 of the FAR effective April 24, 1986.

AUTHORITY: 49 U.S.C. 1354(a), 1421, and 1423; 49 U.S.C. 106(g) (Revised Pub. L. 97-449, January 12, 1983).

Part 33—Airworthiness Standards: Aircraft Engines

Subpart A—General

§ 33.1 Applicability.

(a) The Part prescribes airworthiness standards for the issue of type certificates and changes to those certificates, for aircraft engines.

(b) Each person who applies under Part 21 for such a certificate or change must show compliance with the applicable requirements of this Part.

§ 33.3 General.

Each applicant must show that the aircraft engine concerned meets the applicable requirements of this Part.

[§ 33.4 Instructions for Continued Airworthiness.

[The applicant must prepare Instructions for Continued Airworthiness in accordance with Appendix A to this Part that are acceptable to the Administrator. The instructions may be incomplete at type certification if a program exists to ensure their completion prior to delivery of the first aircraft with the engine installed, or upon issuance of a standard certificate of airworthiness for the aircraft with the engine installed, whichever occurs later.

[§ 33.5 Instruction manual for installing and operating the engine.

[Each applicant must prepare and make available to the Administrator prior to the issuance of the type certificate, and to the owner at the time of delivery of the engine, approval instructions for installing/and operating the engine. The instructions must include at least the following:]

(a) *Installation instructions.* (1) The location of engine mounting attachments, the method of attaching the engine to the aircraft, and the maximum allowable load for the mounting attachments and related structure.

(2) The location and description of engine connections to be attached to accessories, pipes, wires, cables, ducts, and cowling.

(3) An outline drawing of the engine including overall dimensions.

(b) *Operation instructions.* (1) The operating limitations established by the Administrator.

(2) The power of thrust ratings and procedures for correcting for nonstandard atmosphere.

(3) The recommended procedures, under normal and extreme ambient conditions for—

(i) Starting;

(ii) Operating on the ground; and

(iii) Operating during flight.

[(c) [Deleted.]

[(d) [Deleted.]

[(e) [Deleted.]]

§ 33.7 Engine ratings and operating limitations.

(a) Engine ratings and operating limitations are established by the Administrator and included in the engine certificate data sheet specified in § 21.41 of this chapter, including ratings and limitations based on the operating conditions and information specified in this section, as applicable, and any other information found necessary for safe operation of the engine.

(b) For reciprocating engines, ratings and operating limitations are established relating to the following:

(1) Horsepower or torque, r.p.m., manifold pressure, and time at critical pressure altitude and sea level pressure altitude for—

(i) Rated maximum continuous power (relating to unsupercharged operation or to operation in each supercharger mode as applicable); and

(ii) Rated takeoff power (relating to unsupercharged operation or to operation in each supercharger mode as applicable).

(2) Fuel grade or specification.

(3) Oil grade or specification.

(4) Temperature of the—

(i) Cylinder;

(ii) Oil at the oil inlet; and

(iii) Turbosupercharger turbine wheel inlet gas.

(5) Pressure of—

(i) Fuel at the fuel inlet; and

(ii) Oil at the main oil gallery.

(6) Accessory drive torque and overhang moment.

(7) Component life.

(8) Turbosupercharger turbine wheel r.p.m.

(c) For turbine engines, ratings and operating limitations are established relating to the following:

(1) Horsepower, torque, or thrust, r.p.m., gas temperature, and time for—

(i) Rated maximum continuous power or thrust (augmented);

(ii) Rated maximum continuous power or thrust (unaugmented);

(iii) Rated takeoff power or thrust (augmented);

(iv) Rated takeoff power or thrust (unaugmented);

(v) Rated 30 minute power; and

(vi) Rated 2½ minute power.

[(vii) Auxiliary power unit (APU) mode of operation.]

(2) Fuel designation or specification.

(3) Oil grade or specification.

(4) Hydraulic fluid specification.

(5) Temperature of—

(i) Oil at a location specified by the applicant;

(ii) Induction air at the inlet face of a supersonic engine, including steady state operation and transient over-temperature and time allowed;

(iii) Hydraulic fluid of a supersonic engine;

(iv) Fuel at a location specified by the applicant; and

(v) External surfaces of the engine; if specified by the applicant.

(6) Pressure of—

(i) Fuel at the fuel inlet;

(ii) Oil at a location specified by the applicant;

(iii) Induction air at the inlet face of a supersonic engine, including steady state operation and transient overpressure and time allowed; and

(iv) Hydraulic fluid.

(7) Accessory drive torque and overhang moment.

(8) Component life.

(9) Fuel filtration.

(10) Oil filtration.

(11) Bleed air.

(12) The number of start-stop stress cycles approved for each rotor disc and spacer.

(13) Inlet air distortion at the engine inlet.

(14) Transient rotor shaft overspeed r.p.m., and number of overspeed occurrences.

(15) Transient gas ovetemperature, and number of overtemperature occurrences.

(16) For engines to be used in supersonic aircraft, engine rotor windmilling rotational r.p.m.

§ 33.8 Selection of engine power and thrust ratings.

(a) Requested engine power and thrust ratings must be selected by the applicant.

(b) Each selected rating must be for the lowest power or thrust that all engines of the same type may be expected to produce under the conditions used to determine that rating.

Subpart B—Design and Construction: General

§ 33.11 Applicability.

This subpart prescribes the general design and construction requirements for reciprocating and turbine aircraft engines.

§ 33.13 [Reserved]

[§ 33.14 Start-stop cyclic stress (low-cycle fatigue).

[By a procedure approved by the FAA, operating limitations must be established which specify the maximum allowable number of start-stop stress cycles for each rotor structural part (such as discs, spacers, hubs, and shafts of the compressors and turbines), the failure of which could produce a hazard to the aircraft. A start-stop stress cycle consists of a flight cycle profile or an equivalent representation of engine usage. It includes starting the engine, accelerating to maximum rated power or thrust, decelerating, and stopping. For each cycle, the rotor structural parts must reach stabilized temperature during engine operation at maximum rated power or thrust and after engine shutdown, unless it is shown that the parts undergo the same stress range without temperature stabilization.]

§ 33.15 Materials.

The suitability and durability of materials used in the engine must—

(a) Be established on the basis of experience or tests; and

[(b) Conform to approved specifications (such as industry or military specifications) that ensure their having the strength and other properties assumed in the design data.]

[§ 33.17 Fire prevention.

[(a) The design and construction of the engine and the materials used must minimize the probability of the occurrence and spread of fire. In addition, the design and construction of turbine engines must minimize the probability of the occurrence of an internal fire that could result in structural failure, overheating, or other hazardous conditions.]

(b) Except as provided in paragraphs (c), (d), and (e) of this section, each external line, fitting, and other component, which contains or conveys flammable fluid must be fire resistent. Components must be shielded or located to safeguard against the ignition of leaking flammable fluid.

(c) Flammable fluid tanks and supports which are part of and attached to the engine must be fireproof or be enclosed by a fireproof shield unless damage by fire to any non-fireproof part will not cause leakage or spillage of flammable fluid. For a reciprocating engine having an integral oil sump of less than [25-quart] capacity, the oil sump need not be fireproof nor be enclosed by a fireproof shield.

(d) For turbine engines type certificated for use in supersonic aircraft, each external component which conveys or contains flammable fluid must be fireproof.

(e) Unwanted accumulation of flammable fluid and vapor must be prevented by draining and venting.

§ 33.19 Durability.

(a) Engine design and construction must minimize the development of an unsafe condition of the engine between overhaul periods. The design of the compressor and turbine rotor cases must provide for the containment of damage from rotor blade failure. [Energy levels and trajectories of fragments resulting from rotor blade failure that lie outside the compressor and turbine rotor cases must be defined.]

(b) Each component of the propeller blade pitch control system which is a part of the engine type design must meet the requirements of § 35.42 of this chapter.

§ 33.21 Engine cooling.

Engine design and construction must provide the necessary cooling under conditions in which the airplane is expected to operate.

[§ 33.23 Engine mounting attachments and structure

[(a) The maximum allowable limit and ultimate loads for engine mounting attachments and related engine structure must be specified.

[(b) The engine mounting attachments and related engine structure must be able to withstand—

[(1) The specified limit loads without permanent deformation; and

[(2) The specified ultimate loads without failure, but may exhibit permanent deformation.

[§ 33.25 Accessory attachments.

[The engine must operate properly with the accessory drive and mounting attachments loaded. Each engine accessory drive and mounting attachment must include provisions for sealing to prevent contamination of, or unacceptable leakage from, the engine interior. A drive and mounting attachment requiring lubrication for external drive splines, or coupling by engine oil, must include provisions for sealing to prevent unacceptable loss of oil and to prevent contamination from sources outside the chamber enclosing the drive connection. The design of the engine must allow for the examination, adjustment, or removal of each accessory required for engine operation.

[§ 33.27 Turbine, compressor, fan, and turbosupercharger rotors.

[(a) Turbine, compressor, fan, and turbosupercharger rotors must have sufficient strength to withstand the test conditions specified in paragraph (c) of this section.

[(b) The design and functioning of engine control devices, systems, and instruments must give reasonable assurance that those engine operating limitations that affect turbine, compressor, and turbosupercharger rotor structural integrity will not be exceeded in service.

[(c) The most critically stressed rotor component (except blades) of each turbine, compressor, and fan, including integral drum rotors and centrifugal compressors in an engine or turbosupercharger, as determined by analysis or other acceptable means, must be tested for a period of 5 minutes—

[(1) At its maximum operating temperature, except as provided in paragraph (c) (2) (iv) of this section; and

[(2) At the highest speed of the following, as applicable:

[(i) 120 percent of its maximum permissible r.p.m. if tested on a rig and equipped with blades or blade weights.

[(ii) 115 percent of its maximum permissible r.p.m. if tested on an engine.

[(iii) 115 percent of its maximum permissible r.p.m. if tested on a turbosupercharger driven by a hot gas supply from a special burner rig.

[(iv) 120 percent of the r.p.m. at which, while cold spinning, it is subject to operating stresses that are equivalent to those induced at the maximum operating temperature and maximum permissible r.p.m.

[(v) 105 percent of the highest speed that would result from failure of the most critical component or system in a representative installation of the engine.

[(vi) The highest speed that would result from the failure of any component or system in a representative installation of the engine, in combination with any failure of a component or system that would not normally be detected during a routine preflight check or during normal flight operation.

[Following the test, each rotor must be within approved dimensional limits for an overspeed condition and may not be cracked.]

§ 33.29 Instrument connection.

(a) Unless it is constructed to prevent its connection to an incorrect instrument, each connection provided for powerplant instruments required by aircraft airworthiness regulations or necessary to insure operation of the engine in compliance with any engine limitation must be marked to identify it with its corresponding instrument.

(b) A connection must be provided on each turbojet engine for an indicator system to indicate rotor system unbalance.

Subpart C—Design and Construction: Reciprocating Aircraft Engines

§ 33.31 Applicability.

This subpart prescribes additional design and construction requirements for reciprocating aircraft engines.

§ 33.33 Vibration.

The engine must be designed and constructed to function throughout its normal operating range of crankshaft rotational speeds and engine powers without inducing excessive stress in any of the engine parts because of vibration and without imparting excessive vibration forces to the aircraft structure.

§ 33.35 Fuel and induction system.

(a) The fuel system of the engine must be designed and constructed to supply an appropriate mixture of fuel to the cylinders throughout the complete operating range of the engine under all flight and atmospheric conditions.

(b) The intake passages of the engine through which air or fuel in combination with air passes for combustion purposes must be designed and constructed to minimize the danger of ice accretion in those passages. The engine must be designed and constructed to permit the use of a means for ice prevention.

(c) The type and degree of fuel filtering necessary for protection of the engine fuel system against foreign particles in the fuel must be specified. The applicant must show that foreign particles passing through the prescribed filtering means will not critically impair engine fuel system functioning.

(d) Each passage in the induction system that conducts a mixture of fuel and air must be self-draining, to prevent a liquid lock in the cylinders, in all attitudes that the applicant establishes as those the engine can have when the aircraft in which it is installed is in the static ground attitude.

[(e) If provided as part of the engine, the applicant must show for each fluid injection (other than fuel) system and its controls that the flow of the injected fluid is adequately controlled.]

§ 33.37 Ignition system.

Each spark ignition engine must have a dual ignition system with at least two spark plugs for each cylinder and two separate electric circuits with separate sources of electrical energy, or have an ignition system of equivalent in-flight reliability.

§ 33.39 Lubrication system.

(a) The lubrication system of the engine must be designed and constructed so that it will function properly in all flight attitudes and atmospheric conditions in which the airplane is expected to operate. In wet sump engines, this requirement must be met when only one-half of the maximum lubricant supply is in the engine.

(b) The lubrication system of the engine must be designed and constructed to allow installing a means of cooling the lubricant.

(c) The crankcase must be vented to the atmosphere to preclude leakage of oil from excessive pressure in the crankcase.

Subpart D—Block Tests: Reciprocating Aircraft Engines

33.41 Applicability.

This subpart prescribes the block tests and inspections for reciprocating aircraft engines.

§ 33.42 General.

Before each endurance test required by this subpart, the adjustment setting and functioning characteristic of each component having an adjustment setting and a functioning characteristic that can be established independent of installation on the engine must be established and recorded.

§ 33.43 Vibration test.

[(a) Each engine must undergo a vibration survey to establish the torsional and bending vibration characteristics of the crankshaft and the propeller shaft or other output shaft, over the range of crankshaft speed and engine power, under steady state and transient conditions, from idling speed to either 110 percent of the desired maximum continuous speed rating or 103 percent of the maximum desired takeoff speed rating, whichever is higher. The survey must be conducted using, for airplane engines, the same configuration of the propeller type which is used for the endurance test, and using, for other engines, the same configuration of the loading device type which is used for the endurance test.]

(b) The torsional and bending vibration stresses of the crankshaft and the propeller shaft or other output shaft may not exceed the endurance limit stress of the material from which the shaft is made. If the maximum stress in the shaft cannot be shown to be below the endurance limit by measurement, the vibration frequency and amplitude must be measured. The peak amplitude must be shown to produce a stress below the endurance limit; if not, the engine must be run at the condition producing the peak amplitude until, for steel shafts, 10 million stress reversals have been sustained without fatigue failure and, for other shafts, until it is shown that fatigue will not occur within the endurance limit stress of the material.

(c) Each accessory drive and mounting attachment must be loaded, with the loads imposed by each accessory used only for an aircraft service being the limit load specified by the applicant for the drive or attachment point.

[(d) The vibration survey described in paragraph (a) of this section must be repeated with that cylinder not firing which has the most adverse vibration effect, in order to establish the conditions under which the engine can be operated safely in that abnormal state. However, for this vibration survey, the engine speed range need only extend from idle to the maximum desired takeoff speed, and compliance with paragraph (b) of this section need not be shown.]

§ 33.45 Calibration tests.

(a) Each engine must be subjected to the calibration tests necessary to establish its power characteristics and the conditions for the endurance test specified in § 33.49. The results of the power characteristics calibration tests form the basis for establishing the characteristics of the engine over its entire operating range of crankshaft rotational speeds, manifold pressures, fuel/air mixture settings, and altitudes. Power ratings are based upon standard atmospheric conditions with only those accessories installed which are essential for engine functioning.

(b) A power check at sea level conditions must be accomplished on the endurance test engine after the endurance test. Any change in power characteristics which occurs during the endurance test must be determined. Measurements taken during the final portion of the endurance test may be used in showing compliance with the requirements of this paragraph.

§ 33.47 Detonation test.

Each engine must be tested to establish that the engine can function without detonation throughout its range of intended conditions of operation.

§ 33.49 Endurance test.

(a) *General.* Each engine must be subjected to an endurance test that includes a total of 150 hours of operation (except as provided in paragraph (e) (1) (iii) of this section) and, depending upon the type and contemplated use of the engine, consists of one of the series of runs specified in paragraphs (b) through (e) of this section, as applicable. The runs must be made in the order found appropriate by the Administrator for the particular engine being tested. During the endurance test the engine power and the crankshaft rotational speed must be kept within ±3 percent of the rated values. During the runs at rated takeoff power and for at least 35 hours at rated maximum continuous power, one cylinder, must be operated at not less than the limiting temperature, the other cylinders must be operated at a temperature not lower than 50 degrees F below the limiting temperature, and the oil inlet temperature must be maintained within ±10 degrees F of the limiting temperature. An engine that is equipped with a propeller shaft must be fitted for the endurance test with a propeller that thrust-loads the engine to the maximum thrust which the engine is designed to resist at each applicable operating condition specified in this section. Each accessory drive and mounting attachment must be loaded. During operation at rated takeoff power and rated maximum continuous power, the load imposed by each accessory used only for an aircraft service must be the limit load specified by the applicant for the engine drive or attachment point.

(b) *Unsupercharged engines and engines incorporating a gear-driven single-speed supercharger.* For engines not incorporating a supercharger and for engines incorporating a gear-driven single-speed supercharger the applicant must conduct the following runs:

(1) A 30-hour run consisting of alternate periods of 5 minutes at rated takeoff power with takeoff speed, and 5 minutes at maximum best economy cruising power or maximum recommended cruising power.

(2) A 20-hour run consisting of alternate periods of 1½ hours at rated maximum continuous power with maximum continuous speed, and ½ hour at 75 percent rated maximum continuous power and 91 percent maximum continuous speed.

(3) A 20-hour run consisting of alternate periods of 1½ hours at rated maximum continuous power with maximum continuous speed, and ½ hour at 70 percent rated maximum continuous power and 89 percent maximum continuous speed.

(4) A 20-hour run consisting of alternate periods of 1½ hours at rated maximum continuous power with maximum continuous speed, and ½ hour at 65 percent rated maximum continuous power and 87 percent maximum continuous speed.

(5) A 20-hour run consisting of alternate periods of 1½ hours at rated maximum continuous power with maximum continuous speed, and ½ hour at 60 percent rated maximum continuous power and 84.5 percent maximum continuous speed.

(6) A 20-hour run consisting of alternate periods of 1½ hours at rated maximum continuous power with maximum continuous speed, and ½ hour at 50 percent rated maximum continuous power and 79.5 percent maximum continuous speed.

(7) A 20-hour run consisting of alternate periods of 2½ hours at rated maximum continuous power with maximum continuous speed, and 2½ hours at maximum best economy cruising power or at maximum recommended cruising power.

[(c) *Engines incorporating a gear-driven two-speed supercharger.* For engines incorporating a gear-driven two-speed supercharger the applicant must conduct the following runs:]

(1) A 30-hour run consisting of alternate periods in the lower gear ratio of five minutes at rated takeoff power with takeoff speed, and five minutes at maximum best economy cruising power or at maximum recommended cruising power. If a takeoff power rating is desired in the higher gear ratio, 15 hours of the 30-hour run must be made in the higher gear ratio in alternate periods of five minutes at the observed horsepower obtainable with the takeoff critical altitude manifold pressure and takeoff speed, and five minutes at 70 percent high ratio rated maximum continuous power and 89 percent high ratio maximum continuous speed.

(2) A 15-hour run consisting of alternate periods in the lower gear ratio of one hour at rated maximum continuous power with maximum continuous speed, and ½ hour at 75 percent rated maximum continuous power and 91 percent maximum continuous speed.

(3) A 15-hour run consisting of alternate periods in the lower gear ratio of one hour at rated maximum continuous power with maximum continuous speed, and ½ hour at 70 percent rated maximum continuous power and 89 percent maximum continuous speed.

(4) A 30-hour run in the higher gear ratio at rated maximum continuous power with maximum continuous speed.

(5) A 5-hour run consisting of alternate periods of five minutes in each of the supercharger gear ratios. The first five minutes of the test must be made at maximum continuous speed in the higher gear ratio and the observed horsepower obtainable with 90 percent of maximum continuous manifold pressure in the higher gear ratio under sea level conditions. The condition for operation for the alternate five minutes in the lower gear ratio must be that obtained by shifting to the lower gear ratio at constant speed.

(6) A 10-hour run consisting of alternate periods in the lower gear ratio of one hour at rated maximum continuous power with maximum continuous speed, and one hour at 65 percent rated maximum continuous power and 87 percent maximum continuous speed.

(7) A 10-hour run consisting of alternate periods in the lower gear ratio of one hour at rated maximum continuous power with maximum continuous speed, and one hour at 60 percent rated maximum continuous power and 84.5 percent maximum continuous speed.

(8) A 10-hour run consisting of alternate periods in the lower gear ratio of one hour at rated maximum continuous power with maximum continuous speed, and one hour at 50 percent rated maximum continuous power and 79.5 percent maximum continuous speed.

(9) A 20-hour run consisting of alternate periods in the lower gear ratio of 2 hours at rated maximum continuous power with maximum continuous speed, and two hours at maximum best economy cruising power and speed or at maximum recommended cruising power.

(10) A 5-hour run in the lower gear ratio at maximum best economy cruising power and speed or at maximum recommended cruising power and speed.

Where simulated altitude test equipment is not available when operating in the higher gear ratio, the runs may be made at the observed horsepower obtained with the critical altitude manifold pressure or specified percentages thereof, and the fuel-air mixtures may be adjusted to be rich enough to suppress detonation.

(d) *Helicopter engines.* To be eligible for use on a helicopter each engine must either comply with paragraphs (a) through (j) of § 29.923 of this chapter, or must undergo the following series of runs:

(1) A 35-hour run consisting of alternate periods of 30 minutes each at rated takeoff power with takeoff speed, and at rated maximum continuous power with maximum continuous speed.

(2) A 25-hour run consisting of alternate periods of 2½ hours each at rated maximum continuous power with maximum continuous speed, and at 70 percent rated maximum continuous power with maximum continuous speed.

(3) A 25-hour run consisting of alternate periods of 2½ hours each at rated maximum continuous power with maximum continuous speed, and at 70 percent rated maximum continuous power with 80 to 90 percent maximum continuous speed.

(4) A 25-hour run consisting of alternate periods of 2½ hours each at 80 percent rated maximum continuous power with takeoff speed, and at 80 percent rated maximum continuous power with 80 to 90 percent maximum continuous speed.

(5) A 25-hour run consisting of alternate periods of 2½ hours each at 80 percent rated maximum continuous power with takeoff speed, and at either rated maximum continuous power with 110 percent maximum continuous speed or at rated takeoff power with 103 percent takeoff speed, whichever results in the greater speed.

(6) A 15-hour run at 105 percent rated maximum continuous power with 105 percent maximum continuous speed or at full throttle and corresponding speed at standard sea level carburetor entrance pressure, if 105 percent of the rated maximum continuous power is not exceeded.

(e) *Turbosupercharged engines.* For engines incorporating a turbosupercharger the following apply except that altitude testing may be simulated provided the applicant shows that the engine and supercharger are being subjected to mechanical loads and operating temperatures no less severe than if run at actual altitude conditions:

(1) For engines used in airplanes the applicant must conduct the runs specified in paragraph (b) of this section, except—

(i) The entire run specified in paragraph (b) (1) of this section must be made at sea level altitude pressure;

[(ii) The portions of the runs specified in paragraphs (b) (2) through (7) of this section at rated maximum continuous power must be made at critical altitude pressure, and the portions of the runs at other power must be made at 8,000 feet altitude pressure; and]

(iii) The turbosupercharger used during the 150-hour endurance test must be run on the bench for an additional 50 hours at the limiting turbine wheel inlet gas temperature and rotational speed for rated maximum continuous power operation unless the limiting temperature and speed are maintained during 50 hours of the rated maximum continuous power operation.

(2) For engines used in helicopters the applicant must conduct the runs specified in paragraph (d) of this section, except—

(i) The entire run specified in paragraph (d)(1) of this section must be made at critical altitude pressure;

(ii) The portions of the runs specified in paragraph (d)(2) and (3) of this section at rated maximum continuous power must be made at critical altitude pressure and the portions of the runs at other power must be made at 8,000 feet altitude pressure;

(iii) The entire run specified in paragraph (d)(4) of this section must be made at 8,000 feet altitude pressure;

(iv) The portion of the runs specified in paragraph (d)(5) of this section at 80 percent of rated maximum continuous power must be made at 8,000 feet altitude pressure and the portions of the runs at other power must be made at critical altitude pressure;

(v) The entire run specified in paragraph (d)(6) of this section must be made at critical altitude pressure; and

(vi) The turbosupercharger used during the endurance test must be run on the bench for 50 hours at the limiting turbine wheel inlet gas temperature and rotational speed for rated maximum continuous power operation unless the limiting temperature and speed are maintained during 50 hours of the rated maximum continuous power operation.

§ 33.51 Operation test.

The operation test must include the testing found necessary by the Administrator to demonstrate backfire characteristics, starting, idling, acceleration, overspeeding, functioning of propeller and ignition, and any other operational characteristic of the engine. If the engine incorporates a multispeed supercharger driver, the design and construction must allow the supercharger to be shifted from operation at the lower speed ratio to the higher and the power appropriate to the manifold pressure and speed settings for rated maximum continuous power at the higher supercharger speed ratio must be obtainable within five seconds.

§ 33.53 Engine component tests.

(a) For each engine that cannot be adequately substantiated by endurance testing in accordance with § 33.49, the applicant must conduct additional tests to establish that components are able to function reliably in all normally anticipated flight and atmospheric conditions.

(b) Temperature limits must be established for each component that requires temperature controlling provisions in the aircraft installation to assure satisfactory functioning, reliability, and durability.

§ 33.55 Teardown inspection.

After completing the endurance test—

(a) Each engine must be completely disassembled;

(b) Each component having an adjustment setting and a functioning characteristic that can be established independent of installation on the engine must retain each setting and functioning characteristic within the limits that were established and recorded at the beginning of the test; and

(c) Each engine component must conform to the type design and be eligible for incorporation into an engine for continued operation, in accordance with information submitted in compliance with [§ 33.4.]

§ 33.57 General conduct of block tests.

(a) The applicant may, in conducting the block tests, use separate engines of identical design and construction in the vibration, calibration, detonation, endurance, and operation tests, except that, if a separate engine is used for the endurance test it must be subjected to a calibration check before starting the endurance test.

(b) The applicant may service and make minor repairs to the engine during the block tests in accordance with the service and maintenance instructions submitted in compliance with § 33.4. If the frequency of the service is excessive, or the number of stops due to engine malfunction is excessive, or a major repair, or replacement of a part is found necessary during the block tests or as the result of findings from the teardown inspection, the engine or its parts may be subjected to any additional test the Administrator finds necessary.

(c) Each applicant must furnish all testing facilities, including equipment and competent personnel, to conduct the block tests.

Subpart E—Design and Construction: Turbine Aircraft Engines

§ 33.61 Applicability.

This subpart prescribes additional design and construction requirements for turbine aircraft engines.

§ 33.62 Stress analysis.

A stress analysis must be performed on each turbine engine showing the design safety margin of each turbine engine rotor, spacer, and rotor shaft.

§ 33.63 Vibration.

[Each engine must be designed and constructed to function throughout its operating range of rotational speeds and engine power without inducing excessive stress in any engine part because of vibration and without imparting excessive vibration forces to the aircraft structure.]

§ 33.65 Surge and stall characteristics.

When the engine is operated in accordance with operating instructions required by § 33.5 (b), starting, a change of power or thrust, power or thrust augmentation, limiting inlet air distortion, or inlet air temperature may not cause surge or stall to the extent that flameout, structural failure, overtemperature, or failure of the engine to recover power or thrust will occur at any point in the operating envelope.

[§ 33.66 Bleed air system.

[The engine must supply bleed air without adverse effect on the engine, excluding reduced thrust or power output, at all conditions set up to the discharge flow conditions established as a limitation under § 33.7(c) (11). If bleed air used for engine anti-icing can be controlled, provision must be made for a means to indicate the functioning of the engine ice protection system.]

§ 33.67 Fuel system.

[(a) With fuel supplied to the engine at the flow and pressure specified by the applicant, the engine must function properly under each operating condition required by this Part. Each fuel control adjusting means that may not be manipulated while the fuel control device is mounted on the engine must be secured by a locking device and sealed, or otherwise be inaccessible. All other fuel control adjusting means must be accessible and marked to indicate the functioning of the adjustment unless the function is obvious.]

(b) There must be a fuel strainer or filter between the engine fuel inlet opening and the inlet of either the fuel metering device or the engine-driven positive displacement pump whichever is nearer the engine fuel inlet. In addition, the following provisions apply to each strainer or filter required by this paragraph:

(1) It must be accessible for draining and cleaning and must incorporate a screen or element that is easily removable.

(2) It must have a sediment trap and drain except that it need not have a drain if the strainer or filter is easily removable for drain purposes.

[(3) It must be mounted so that its weight is not supported by the connecting lines or by the inlet or outlet connections of the strainer or filter, unless adequate strength margins under all loading conditions are provided in the lines and connections.

[(4) It must have the type and degree of fuel filtering specified as necessary for protection of the engine fuel system against foreign particles in the fuel. The applicant must show:

[(i) That foreign particles passing through the specified filtering means do not impair the engine fuel system functioning; and

[(ii) That the fuel system is capable of sustained operation throughout its flow and pressure range with the fuel initially saturated with water at 80°F (27°C) and having 0.025 fluid ounces per gallon (0.20 milliliters per liter) of free water added and cooled to the most critical condition for icing likely to be encountered in operation. However, this requirement may be met by demonstrating the effectiveness of specified approved fuel anti-icing additives, or that the fuel system incorporates a fuel heater which maintains the fuel temperature at the fuel strainer or fuel inlet above 32°F (0°C) under the most critical conditions.

[(5) The applicant must demonstrate that the filtering means has the capacity (with respect to engine operating limitations) to ensure that the engine will continue to operate within approved limits, with fuel contaminated to the maximum degree of particle size and density likely to be encountered in service. Operation under these conditions must be demonstrated for a period acceptable to the Administrator, beginning when indication of impending filter blockage is first given by either:

[(i) Existing engine instrumentation; or

[(ii) Additional means incorporated into the engine fuel system.]

(6) Any strainer or filter bypass must be designed and constructed so that the release of collected contaminants is minimized by appropriate location of the bypass to ensure that collected contaminants are not in the bypass flow path.

[(c) If provided as part of the engine, the applicant must show for each fluid injection (other than fuel) system and its controls that the flow of the injected fluid is adequately controlled.]

§ 33.68 Induction system icing.

Each engine, with all icing protection systems operating, must—

(a) Operate throughout its flight power range (including idling) without the accumulation of ice on the engine components that adversely affects engine operation or that causes a serious loss of power or thrust in continuous maximum and intermittent maximum icing conditions as defined in Appendix C of Part 25 of this chapter; and

[(b) Idle for 30 minutes on the ground, with the available air bleed for icing protection at its critical condition, without adverse effect, in an atmosphere that is at a temperature between 15° and 30°F (between −9° and −1°C) and has a liquid water content not less than 0.3 grams per cubic meter in the form of drops having a mean effective diameter not less than 20 microns, followed by a momentary operation at takeoff power or thrust. During the 30 minutes of idle operation the engine may be run up periodically to a moderate power or thrust setting in a manner acceptable to the Administrator.]

§ 33.69 Ignitions system.

Each engine must be equipped with an ignition system for starting the engine on the ground and in flight. An electric ignition system must have at least two igniters and two separate secondary electric circuits, except that only one igniter is required for fuel burning augmentation systems.

§ 33.71 Lubrication system.

(a) *General.* Each lubrication system must function properly in the flight attitudes and atmospheric conditions in which an aircraft is expected to operate.

[(b) *Oil strainer or filter.* There must be an oil strainer or filter through which all of the engine oil flows. In addition.]

(1) Each strainer or filter required by this paragraph that has a bypass must be constructed and installed so that oil will flow at the normal rate through the rest of the system with the strainer or filter element completely blocked.

(2) The type and degree of filtering necessary for protection of the engine oil system against foreign particles in the oil must be specified. The applicant must demonstrate that foreign particles passing through the specified filtering means do not impair engine oil system functioning.

[(3) Each strainer or filter required by this paragraph must have the capacity (with respect to operating limitations established for the engine) to ensure that engine oil system functioning is not impaired with the oil contaminated to a degree (with respect to particle size and density) that is greater than that established for the engine in subparagraph (2) of this paragraph.

[(4) For each strainer or filter required by this paragraph, except the strainer or filter at the oil tank outlet, there must be means to indicate contamination before it reaches the capacity established in accordance with paragraph (b) (3) of this section.]

(5) Any filter bypass must be designed and constructed so that the release of collected contaminants is minimized by appropriate location of the bypass to ensure that the collected contaminants are not in the bypass flow path.

(6) Each strainer or filter required by this paragraph that has no bypass, except the strainer or filter at an oil tank outlet or for a scavenge pump, must have provisions for connection with a warning means to warn the pilot of the occurrence of contamination of the screen before it reaches the capacity established in accordance with subparagraph (3) of this paragraph.

(7) Each strainer or filter required by this paragraph must be accessible for draining and cleaning.

(c) *Oil tanks.* (1) Each oil tank must have an expansion space of not less than 10 percent of the tank capacity.

(2) It must be impossible to inadvertently fill the oil tank expansion space.

(3) Each recessed oil tank filler connection that can retain any appreciable quantity of oil must have provision for fitting a drain.

(4) Each oil tank cap must provide an oil-tight seal.

[(5) Each oil tank filler must be marked with the word "oil".]

(6) Each oil tank must be vented from the top part of the expansion space, with the vent so arranged that condensed water vapor that might freeze and obstruct the line cannot accumulate at any point.

(7) There must be means to prevent entrance into the oil tank or into any oil tank outlet, of any object that might obstruct the flow of oil through the system.

(8) There must be a shutoff valve at the outlet of each oil tank, unless the external portion of the oil system (including oil tank supports) is fireproof.

(9) Each unpressurized oil tank may not leak when subjected to maximum operating temperature and an internal pressure of 5 p.s.i., and each pressurized oil tank may not leak when subjected to maximum operating temperature and an internal pressure that is not less than 5 p.s.i. plus the maximum operating pressure of the tank.

(10) Leaked or spilled oil may not accumulate between the tank and the remainder of the engine.

[(11) Each oil tank must have an oil quantity indicator or provisions for one.

[(12) If the propeller feathering system depends on engine oil—

[(i) There must be means to trap an amount of oil in the tank if the supply becomes depleted due to failure of any part of the lubricating system other than the tank itself;

[(ii) The amount of trapped oil must be enough to accomplish the feathering operation and must be available only to the feathering pump; and

[(iii) Provision must be made to prevent sludge or other foreign matter from affecting the safe operation of the propeller feathering system.

[(d) *Oil drains.* A drain (or drains) must be provided to allow safe drainage of the oil system. Each drain must—

[(1) Be accessible; and

[(2) Have manual or automatic means for positive locking in the closed position.]

(e) *Oil radiators.* Each oil radiator must withstand, without failure, any vibration, inertia, and oil pressure load to which it is subjected during the block tests.

§ 33.72 Hydraulic actuating systems.

Each hydraulic actuating system must function properly under all conditions in which the engine is expected to operate. Each filter or screen must be accessible for servicing and each tank must meet the design criteria of § 33.71.

33.73 Power or thrust response.

The design and construction of the engine must enable an increase—

(a) From minimum to rated takeoff power or thrust with the maximum bleed air and power extraction to be permitted in an aircraft, without overtemperature, surge, stall, or other detrimental factors occurring to the engine whenever the power control lever is moved from the minimum to the maximum position in not more than 1 second, except that the Administrator may allow additional time increments for different regimes of control operation requiring control scheduling; and

(b) From the fixed minimum flight idle power lever position when provided, or if not provided, from not more than 15% of the rated takeoff power or thrust available to 95% rated takeoff power or thrust in not over 5 seconds. The 5-second power or thrust response must occur from a stabilized static condition using only the bleed air and accessories loads necessary to run the engine. This takeoff rating is specified by the applicant and need not include thrust augmentation.

§ 33.75 Safety analysis.

It must be shown by analysis that any probable malfunction or any probable single or multiple failure, or any probable improper operation of the engine will not cause the engine to—

(a) Catch fire;

[(b) Burst (release hazardous fragments through the engine case);

[(c) Generate loads greater than those ultimate loads specified in § 33.23(a); or]

(d) Lose the capability of being shut down.

[§ 33.77 Foreign object ingestion.

[(a) Ingestion of a 4-pound bird, under the conditions prescribed in paragraph (e) of this section, may not cause the engine to—

[(1) Catch fire;

[(2) Burst (release hazardous fragments through the engine case);

[(3) Generate loads greater than those ultimate loads specified in § 33.23(a); or

[(4) Lose the capability of being shut down.

[(b) Ingestion of 3-ounce birds or 1½-pound birds, under the conditions prescribed in paragraph (e) of this section, may not—

[(1) Cause more than a sustained 25 percent power or thrust loss;

[(2) Require the engine to be shut down within 5 minutes from time of ingestion; or

[(3) Result in a potentially hazardous condition.

[(c) Ingestion of water, ice, or hail, under the conditions prescribed in paragraph (e) of this section, may not cause a sustained power or thrust loss or require the engine to be shut down. It must be demonstrated that the engine can accelerate and decelerate safely while inducting a mixture of at least 4 percent water by weight of engine airflow following stabilized operation at both flight idle and takeoff power settings with at least a 4 percent water-to-air ratio.

[(d) For an engine that incorporates a protection device, compliance with this section need not be demonstrated with respect to foreign objects to be ingested under the conditions prescribed in paragraph (e) of this section if it is shown that—

[(1) Such foreign objects are of a size that will not pass through the protective device;

[(2) The protective device will withstand the impact of the foreign objects; and

[(3) The foreign object, or objects, stopped by the protective device will not obstruct the flow of induction air into the engine with a resultant sustained reduction in power or thrust greater than those values required by paragraphs (b) and (c) of this section.

[(e) Compliance with paragraphs (a), (b), and (c) of this section must be shown by engine test under the following ingestion conditions:

[*Foreign Object*	*Test quantity*	*Speed of foreign object*	*Engine operation*	*Ingestion*
BIRDS:				
3-ounce size	One for each 50 square inches of inlet area or fraction thereof up to a maximum of 16 birds. Three-ounce bird ingestion not required if a 1½-pound bird will pass the inlet guide vanes into the rotor blades.	Liftoff speed of typical aircraft.	Takeoff	In rapid sequence to simulate a flock encounter and aimed at selected critical areas.
1½-pound size	One for the first 300 square inches of inlet area, if it can enter the inlet, plus one for each additional 600 square inches of inlet area or fraction thereof up to a maximum of 8 birds.	Initial climb speed of typical aircraft.	Takeoff	In rapid sequence to simulate a flock encounter and aimed at selected critical areas.
4-pound size	One, if it can enter the inlet.	Maximum climb speed of typical aircraft if the engine has inlet guide vanes.	Maximum cruise.	Aimed at critical area.
		Liftoff speed of typical aircraft, if the engine does not have inlet guide vanes.	Takeoff	Aimed at critical area.
ICE:				
	Maximum accumulation on a typical inlet cowl and engine face resulting from a 2-minute delay in actuating anti-icing system, or a slab of ice which is comparable in weight or thickness for that size engine.	Sucked in.	Maximum cruise.	To simulate a continuous maximum icing encounter at 25°F.

[*Foreign Object*	*Test quantity*	*Speed of foreign object*	*Engine operation*	*Ingestion*
HAIL:				
(0.8 to 0.9 specific gravity)	For all engines: With inlet area of not more than 100 square inches: one 1-inch hailstone. With inlet area of more than 100 square inches: one 1-inch and one 2-inch hailstone for each 150 square inches of inlet area or fraction thereof.	Rough air flight speed of typical aircraft.	Maximum cruise at 15,000 feet altitude.	In a volley to simulate a hailstone encounter. One-half the number of hailstones aimed at random area over the face of the inlet and the other half aimed at the critical face area.
	For supersonic engines (in addition): 3 hailstones each having a diameter equal to that in a straight line variation from 1 inch at 35,000 feet to ¼ inch at 60,000 feet using diameter corresponding to the lowest supersonic cruise altitude expected.	Supersonic cruise velocity. Alternatively, use subsonic velocities with larger hailstones to give equivalent kinetic energy.	Maximum cruise	Aimed at critical engine face area.
WATER:				
	At least 4 percent of engine airflow by weight.	Sucked in.	Flight idle, acceleration, takeoff, deceleration.	For 3 minutes each at idle and takeoff, and during acceleration and deceleration in spray to simulate rain.

Note: The term "inlet area" as used in this section means the engine inlet projected area at the front face of the engine. It includes the projected area of any spinner or bullet nose that is provided.]

§ 33.79 Fuel burning thrust augmentor.

Each fuel burning thrust augmentor, including the nozzle, must—

(a) Provide cutoff of the fuel burning thrust augmentor;

(b) Permit on-off cycling;

(c) Be controllable within the intended range of operation;

(d) Upon a failure or malfunction of augmentor combustion, not cause the engine to lose thrust other than that provided by the augmentor; and

(e) Have controls that function compatibly with the other engine controls and automatically shut off augmentor fuel flow if the engine rotor speed drops below the minimum rotational speed at which the augmentor is intended to function.

Subpart F—Block Tests: Turbine Aircraft Engines

§ 33.81 Applicability.

This subpart prescribes the block tests and inspections for turbine engines.

§ 33.82 General.

Before each endurance test required by this subpart, the adjustment setting and functioning characteristic of each component having an adjustment setting and a functioning characteristic that can be established independent of installation on the engine must be established and recorded.

[§ 33.83 Vibration test.

[(a) Each engine must undergo a vibration survey to establish the vibration characteristics of the rotor discs, rotor blades, rotor shafts, stator blades, and any other components that are subject to vibratory exciting forces which could induce failure at the maximum inlet distortion limit. The survey is to cover the range of rotor speeds and engine power or thrust, under steady state and transient conditions, from idling speed to 103 percent of the maximum permissible speed. The survey must be conducted using the same configuration of the loading device which is used for the endurance test, except that the Administrator may allow the use of a modified configuration if that loading device type is incompatible with the necessary vibration instrumentation.

[(b) The vibration stresses (or strains) of rotor and stator components determined under paragraph (a) of this section must be less, by a margin acceptable to the Administrator, than the endurance limit of the material from which these parts are made, adjusted for the most severe operating conditions.]

(c) Each accessory drive and mounting attachment must be loaded, with the load imposed by each accessory used only for an aircraft service being the limit load specified by the applicant for the engine drive or attachment point.

§ 33.85 Calibration tests.

(a) Each engine must be subjected to those calibration tests necessary to establish its power characteristics and the conditions for the endurance test specified in § 33.87. The results of the power characteristics calibration tests form the basis for establishing the characteristics of the engine over its entire operating range of speeds, pressures, temperatures, and altitudes. Power ratings are based upon standard atmospheric conditions with no airbleed for aircraft services and with only those accessories installed which are essential for engine functioning.

(b) A power check at sea level conditions must be accomplished on the endurance test engine after the endurance test and any change in power characteristics which occurs during the endurance test must be determined. Measurements taken during the final portion of the endurance test may be used in showing compliance with the requirements of this paragraph.

[§ 33.87 Endurance test.

[(a) *General.* Each engine must be subjected to an endurance test that includes a total of 150 hours of operation and, depending upon the type and contemplated use of the engine, consists of one of the series of runs specified in paragraphs (b) through (e) of this section, as applicable. For engines tested under paragraph (b), (c), or (d) of this section, the prescribed 6-hour test sequence must be conducted 25 times to complete the required 150 hours of operation. The following test requirements apply:]

(1) The runs must be made in the order found appropriate by the Administrator for the particular engine being tested.

(2) Any automatic engine control that is part of the engine must control the engine during the endurance test except for operations where automatic control is normally overridden by manual control or where manual control is otherwise specified for a particular test run.

[(3) Except as provided in paragraph (a) (5) of this section, power or thrust, gas temperature, rotor shaft rotational speed, and, if limited, temperature of external surfaces of the engine must be at least 100 percent of the value associated with the particular engine operation being tested. More than one test may be run if all parameters cannot be held at the 100 percent level simultaneously.]

(4) The runs must be made using fuel, lubricants and hydraulic fluid which conform to the specifications specified in complying with § 33.7(c).

[(5) Maximum air bleed for engine and aircraft services must be used during at least one-fifth of the runs. However, for these runs, the power or thrust or the rotor shaft rotational speed may be less than 100 percent of the value associated with the particular operation being tested if the Administrator finds that the validity of the endurance test is not compromised.

[(6) Each accessory drive and mounting attachment must be loaded. The load imposed by each accessory used only for aircraft service must be the limit load specified by the applicant for the engine drive and attachment point during rated maximum continuous power or thrust and higher output. The endurance test of any accessory drive and mounting attachment under load may be accomplished on a separate rig if the validity of the test is confirmed by an approved analysis.]

(7) During the runs at any rated power or thrust the gas temperature and the oil inlet temperature must be maintained at the limiting temperature except where the test periods are not longer than 5 minutes and do not allow stabilization. At least one run must be made with fuel, oil, and hydraulic fluid at the minimum pressure limit and at least one run must be made with fuel, oil, and hydraulic fluid at the maximum pressure limit with fluid temperature reduced as necessary to allow maximum pressure to be attained.

(8) If the number of occurrences of either transient rotor shaft overspeed or transient gas overtemperature is limited, that number of the accelerations required by paragraphs (b), (c), (d), and (e) of this section must be made at the limiting overspeed or overtemperature. If the number of occurrences is not limited, half the required accelerations must be made at the limiting overspeed or overtemperature.

(9) For each engine type certificated for use on supersonic aircraft the following additional test requirements apply:

(i) To change the thrust setting, the power control lever must be moved from the initial position to the final position in not more than one second except for movements into the fuel burning thrust augmentor augmentation position if additional time to confirm ignition is necessary.

(ii) During the runs at any rated augmented thrust the hydraulic fluid temperature must be maintained at the limiting temperature except where the test periods are not long enough to allow stabilization.

(iii) During the simulated supersonic runs the fuel temperature and induction air temperature may not be less than the limiting temperature.

(iv) The endurance test must be conducted with the fuel burning thrust augmentor installed, with the primary and secondary exhaust nozzles installed, and with the variable area exhaust nozzles operated during each run according to the methods specified in complying with § 33.5(b).

(v) During the runs at thrust settings for maximum continuous thrust and percentages thereof, the engine must be operated with the inlet air distortion at the limit for those thrust settings.

(b) *Engines other than certain helicopter engines.* For each engine, except a helicopter engine for which a rating is desired under paragraph (c) or (d) of this section, the applicant must conduct the following runs:

(1) *Takeoff and idling.* One hour of alternate 5-minute periods at rated takeoff power and thrust and at idling power and thrust. The developed powers and thrusts at takeoff and idling conditions and their corresponding rotor speed and gas temperature conditions must be as established by the power control in accordance with the schedule established by the manufacturer. The applicant may, during any one period, manually control the rotor speed, power, and thrust while taking data to check performance. For engines with augmented takeoff power ratings that involve increases in turbine inlet temperature, rotor speed, or shaft power, this period of running at takeoff must be at the augmented rating. For engines that do not materially increase operating severity, the amount of running conducted at the augmented rating is determined by the Administrator. In changing the power setting after each period, the power-control lever must be moved in the manner prescribed in subparagraph (5) of this paragraph.

(2) *Rated maximum continuous and takeoff power and thrust.* Fifteen periods each of 30 minutes' duration at rated maximum continuous power and thrust and 10 periods each of 30 minutes' duration at rated takeoff power and thrust.

(3) *Rated maximum continuous power and thrust.* One hour and 30 minutes at rated maximum continuous power and thrust.

(4) *Incremental cruise power and thrust.* Two hours and 30 minutes at the successive power lever positions corresponding to at least 15 approximately equal speed and time increments between maximum continuous engine rotational speed and ground or minimum idle rotational speed. For engines operating at constant speed, the thrust and power may be varied in place of speed. If there is significant peak vibration anywhere between ground idle and maximum continuous conditions, the number of increments chosen may be changed to increase the amount of running made while subject to the peak vibrations up to not more than 50 percent of the total time spent in incremental running.

(5) *Acceleration and deceleration runs.* Thirty minutes of accelerations and decelerations, consisting of 6 cycles from idling power and thrust to rated takeoff power and thrust and maintained at the takeoff power level position for 30 seconds and at the idling power lever position for approximately 4½ minutes. In complying with this subparagraph, the power-control lever must be moved from one extreme position to the other in not more than 1 second, except that, if different regimes of control operations are incorporated necessitating scheduling of the power-control lever motion in going from one extreme position to the other, a longer period of time is acceptable, but not more than 2 seconds.

(6) *Starts.* One hundred starts must be made, of which 25 starts must be preceded by at least a 2-hour engine shutdown. There must be at least 10 false engine starts, pausing for the applicant's specified minimum fuel drainage time, before attempting a normal start. There must be at least 10 normal restarts with not longer than 15 minutes since engine shutdown. The remaining starts may be made after completing the 150 hours of endurance testing.

(7) [Deleted]

(c) *Helicopter engines for which a 30-minute power rating is desired.* For each helicopter engine for which a 30-minute power rating is desired the applicant must conduct the following series of tests:

(1) *Takeoff and idling.* One hour of alternate 5-minute periods at rated takeoff power and thrust and at idling power and thrust. The developed powers and thrusts

at takeoff and idling conditions and their corresponding rotor speed and gas temperature conditions must be as established by the power control in accordance with the schedule established by the manufacturer. During any one period the rotor speed, power, and thrust may be controlled manually while taking data to check performance. For engines with augmented takeoff power ratings that involve increases in turbine inlet temperature, rotor speed, or shaft power, this period of running at rated takeoff power must be at the augmented power rating. In changing the power setting after each period, the power-control lever must be moved in the manner prescribed in subparagraph (5) of this paragraph.

(2) *Rated 30-minute power.* Thirty minutes at rated 30-minute power and thrust.

(3) *Rated maximum continuous power and thrust.* Two hours at rated maximum continuous power and thrust.

(4) *Incremental cruise power and thrust.* Two hours at the successive power-lever positions corresponding with not less than 12 approximately equal speed and time increments between maximum continuous engine rotational speed and ground or minimum idle rotational speed. For engines operating at constant speed, the thrust and power may be varied in place of speed. If there are significant peak vibrations anywhere between ground idle and maximum continuous conditions, the number of increments chosen must be changed to increase the amount of running conducted while being subjected to the peak vibrations up to not more than 50 percent of the total time spent in incremental running.

(5) *Acceleration and deceleration runs.* Thirty minutes of accelerations and decelerations, consisting of six cycles from idling power and thrust to rated takeoff power and thrust and maintained at the takeoff power-level position for 30 seconds and at the idling power-lever position for approximately 4½ minutes. In complying with this subparagraph, the power-control lever must be moved from one extreme position to the other in not more than 1 second, except that, if different regimes of control operations are incorporated necessitating scheduling of the power-control lever motion in going from one extreme position to the other, a longer period of time is acceptable, but not more than 2 seconds.

(6) *Starts.* One hundred starts, of which 25 starts must be preceded by at least a 2-hour engine shutdown. There must be at least 10 false engine starts, pausing for the applicant's specified minimum fuel drainage time, before attempting a normal start. There must be at least 10 normal restarts with not longer than 15 minutes since engine shutdown. The remaining starts may be made after completing the 150 hours of endurance testing.

(7) [Deleted]

(d) *Helicopter engines for which a 2½ minute power rating is desired.* For each helicopter engine for which a 2½-minute power rating is desired the applicant must conduct the following series of tests:

(1) One hour of alternate 5-minute periods at rated takeoff power and thrust and at idling power and thrust except that, during the third and sixth takeoff power periods, only 2½ minutes need be conducted at rated takeoff power and the remaining 2½ minutes must be conducted at rated 2½ minute power. The developed powers and thrusts, at takeoff, 2½ minute, and idling conditions and their corresponding rotor speed and gas temperature conditions must be as established by the power control in accordance with the schedule established by the manufacturer. The applicant may, during any one period, control manually the rotor speed, power, and thrust while taking data to check performance. For engines with augmented takeoff power ratings that involve increases in turbine inlet temperature, rotor speed, or shaft power, this period of running at rated takeoff power must be at the augmented rating. In changing the power setting after or during each period, the power control lever must be moved in the manner prescribed in subparagraph (5) of paragraph (c) of this section.

[(2) In each 6-hour test sequence specified in paragraph (c) of this section, 30 minutes must be run at rated 30-minute power except that the last 5 minutes of one rated 30-minute power test period must be run at 2½-minute power.]

[(3) The tests required in paragraphs (c) (3) through (c) (6) of this section.]

(e) *Supersonic aircraft engines.* For each engine type certificated for use on supersonic aircraft the applicant must conduct the following:

(1) *Subsonic test under sea level ambient atmospheric conditions.* Thirty runs of one hour each must be made, consisting of—

(i) Two periods of 5 minutes at rated takeoff augmented thrust each followed by 5 minutes at idle thrust;

(ii) One period of 5 minutes at rated takeoff thrust followed by 5 minutes at not more than 15 percent of rated takeoff thrust;

(iii) One period of 10 minutes at rated takeoff augmented thrust followed by 2 minutes at idle thrust, except that if rated maximum continuous augmented thrust is lower than rated takeoff augmented thrust, 5 of the 10-minute periods must be at rated maximum continuous augmented thrust; and

(iv) Six periods of 1 minute at rated takeoff augmented thrust each followed by 2 mintues, including acceleration and deceleration time, at idle thrust.

(2) *Simulated supersonic test.* Each run of the simulated supersonic test must be preceded by changing the inlet air temperature and pressure from that attained at subsonic condition to the temperature and pressure attained at supersonic velocity, and must be followed by a return to the temperature attained at subsonic condition. Thirty runs of 4 hours each must be made, consisting of—

(i) One period of 30 minutes at the thrust obtained with the power control lever set at the position for rated maximum continuous augmented thrust followed by 10 minutes at the thrust obtained with the power control lever set at the position for 90 percent of rated maximum continuous augmented thrust. The end of this period in the first five runs must be made with the induction air temperature at the limiting condition of transient overtemperature, but need not be repeated during the periods specified in subdivisions (ii) through (iv) of this subparagraph;

(ii) One period repeating the run specified in subdivision (i) of this subparagraph, except that it must be followed by 10 minutes at the thrust obtained with the power control lever set at the position for 80 percent of rated maximum continuous augmented thrust;

(iii) One period repeating the run specified in subdivision (i) of this subparagraph, except that it must be followed by 10 minutes at the thrust obtained with the power control lever set at the position for 60 percent of rated maximum continuous augmented thrust and then 10 minutes at not more than 15 percent of rated takeoff thrust;

(iv) One period repeating the runs specified in subdivisions (i) and (ii) of this subparagraph; and

(v) One period of 30 minutes with 25 of the runs made at the thrust obtained with the power control lever set at the position for rated maximum continuous augmented thrust, each followed by idle thrust and with the remaining 5 runs at the thrust obtained with the power control lever set at the position for rated maximum continuous augmented thrust for 25 minutes each, followed by subsonic operation at not more than 15 percent of rated takeoff thrust and accelerated to rated takeoff thrust for 5 minutes using hot fuel.

(3) *Starts.* One hundred starts must be made, of which 25 starts must be preceded

by an engine shutdown of at least 2 hours. There must be at least 10 false engine starts, pausing for the applicant's specified minimum fuel drainage time before attempting a normal start. At least 10 starts must be normal restarts, each made no later than 15 minutes after engine shutdown. The starts may be made at any time, including the period of endurance testing.

[§ 33.88 Engine overtemperature test.

[Each engine must be run for 5 minutes at maximum permissible r.p.m. and with the gas temperature at least 75°F (42°C) higher than the maximum operating limit. Following this run, the turbine assembly must be within serviceable limits.]

§ 33.89 Operation test.

(a) The operation test must include testing found necessary by the Administrator to demonstrate—

(1) Starting, idling, acceleration, overspeeding, ignition, functioning of the propeller (if the engine is designated to operate with a propeller);

(2) Compliance with the engine response requirements of § 33.73; and

(3) The minimum power or thrust response time to 95% rated takeoff power or thrust, from power lever positions representative of minimum idle and of minimum flight idle, starting from stabilized idle operation, under the following engine load conditions:

(i) No bleed air and power extraction for aircraft use.

(ii) Maximum allowable bleed air and power extraction for aircraft use.

(iii) An intermediate value for bleed air and power extraction representative of that which might be used as a maximum for aircraft during approach to a landing.

(4) If testing facilities are not available, the determination of power extraction required in subparagraphs (2) and (3) of paragraph (c) of this section may be accomplished through appropriate analytical means.

[(b) The operation test must include all testing found necessary by the Administrator to demonstrate that the engine has safe operating characteristics throughout its specified operating envelope.

[§ 33.90 Initial maintenance inspection.

[Each engine, except engines being type certificated through amendment of an existing type certificate or through supplemental type certification procedures, must undergo an approved test run that simulates the conditions in which the engine is expected to operate in service, including start-stop cycles, to establish when the initial maintenance inspection is required. The test run must be accomplished on an engine which substantially conforms to the final type design.]

§ 33.91 Engine component tests.

(a) For those systems that cannot be adequately substantiated by endurance testing in accordance with the provisions of § 33.87, additional tests must be made to establish that components are able to function reliably in all normally anticipated flight and atmospheric conditions.

(b) Temperature limits must be established for those components that require temperature controlling provisions in the aircraft installation to assure satisfactory functioning, reliability, and durability.

§ 33.92 Windmilling tests.

(a) [For engines to be used in supersonic aircraft,] unless means are incorporated in the engine to stop rotation of the engine rotors when the engine is shut down in flight, each engine rotor must either seize or be capable of rotation for 3 hours at the limiting windmilling rotational r.p.m. with no oil in the engine system, without the engine—

(1) Catching fire;

[(2) Bursting (releasing hazardous uncontained fragments); or

[(3) Generating loads greater than those ultimate loads specified in § 33.23(a).]

(b) A turbojet or turbofan engine incorporating means to stop rotation of the engine rotors when the engine is shut down in flight must be subjected to 25 operations under the following conditions:

(1) Each engine must be shut down while operating at rated maximum continuous thrust.

(2) For engines certificated for use on supersonic aircraft, the temperature of the induction air and the external surfaces of the engine must be held at the maximum limit during the tests required by this paragraph.

(c) Each unpressurized hydraulic fluid tank may not fail or leak when subjected to maximum operating temperature and an internal pressure at 5 p.s.i., and each pressurized hydraulic fluid tank may not fail or leak when subjected to maximum operating temperature and an internal pressure not less than 5 p.s.i. plus the maximum operating pressure of the tank.

(d) For an engine type certificated for use in supersonic aircraft, the systems, safety devices, and external components that may fail because of operation at maximum and minimum operating temperatures must be identified and tested at maximum and minimum operating temperatures and while temperature and other operating conditions are cycled between maximum and minimum operating values.

§ 33.93 Teardown inspection.

After completing the endurance test each engine must be completely disassembled, and—

(a) Each component having an adjustment setting and a functioning characteristic that can be established independent of installation on the engine must retain each setting and functioning characteristic within the limits that were established and recorded at the beginning of the test; and

(b) Each engine [part] must conform to the type design and be eligible for incorporation into an engine for continued operation, in accordance with information submitted in compliance with § 33.4.

[§ 33.94 Blade containment and rotor unbalance tests.

[(a) Except as provided in paragraph (b) of this section, it must be demonstrated by engine tests that the engine is capable of containing damage without catching fire and without failure of its mounting attachments when operated for at least 15 seconds, unless the resulting engine damage induces a self shutdown, after each of the following events:

[(1) Failure of the most critical compressor or fan blade while operating at maximum permissible r.p.m. The blade failure must occur at the outermost retention groove or, for integrally-bladed rotor discs, at least 80 percent of the blade must fail.

[(2) Failure of the most critical turbine blade while operating at maximum permissible r.p.m. The blade failure must occur at the outermost retention groove or, for integrally-bladed rotor discs, at least 80 percent of the blade must fail. The most critical turbine blade must be determined by considering turbine blade weight and the strength of the adjacent turbine case at case temperatures and pressures associated with operation at maximum permissible r.p.m.

[(b) Analysis based on rig testing, component testing, or service experience may be substituted for one of the engine tests prescribed in paragraphs (a) (1) and (a) (2) of this section if—

[(1) That test, of the two prescribed, produces the least rotor unbalance; and

[(2) The analysis is shown to be equivalent to the test.]

§ 33.95 Engine-propeller systems tests.

If the engine is designed to operate with a propeller, the following tests must be made with a representative propeller installed by either including the tests in the endurance run or otherwise performing them in a manner acceptable to the Administrator:

(a) Feathering operation: 25 cycles.

(b) Negative torque and thrust system operation: 25 cycles from rated maximum continuous power.

(c) Automatic decoupler operation: 25 cycles from rated maximum continuous power (if repeated decoupling and recoupling in service is the intended function of the device).

(d) Reverse thrust operation: 175 cycles from the flight-idle position to full reverse and 25

cycles at rated maximum continuous power from full forward to full reverse thrust. At the end of each cycle the propeller must be operated in reverse pitch for a period of 30 seconds at the maximum rotational speed and power specified by the applicant for reverse pitch operation.

[§33.96 Engine tests in auxiliary power unit (APU) mode.

[If the engine is designed with a propeller brake which will allow the propeller to be brought to a stop while the gas generator portion of the engine remains in operation, and remain stopped during operation of the engine as an auxiliary power unit ("APU mode"), in addition to the requirements of § 33.87, the applicant must conduct the following tests:

[(a) Ground locking: A total of 45 hours with propeller brake engaged in a manner which clearly demonstrates its ability to function without adverse effects on the complete engine while the engine is operating in the APU mode under the maximum conditions of engine speed, torque, temperature, air bleed, and power extraction as specified by the applicant.

[(b) Dynamic braking: A total of 400 application-release cycles of brake engagements must be made in a manner which clearly demonstrates its ability of function without adverse effects on the complete engine under the maximum conditions of engine acceleration/deceleration rate, speed, torque, and temperature as specified by the applicant. The propeller must be stopped prior to brake release.

[(c) One hundred engine starts and stops with the propeller brake engaged.

[(d) The tests required by paragraphs (a), (b), and (c) of this section must be performed on the same engine, but this engine need not be the same engine used for the tests required by § 33.87.

[(e) The tests required by paragraphs (a), (b), and (c) of this section must be followed by engine disassembly to the extent necessary to show compliance with the requirements of § 33.93(a) and § 33.93(b).]

§ 33.97 Thrust reversers.

(a) If the engine incorporates a reverser, the endurance, calibration, operation, and vibration tests prescribed in this subpart must be run with the reverser installed. In complying with this section, the power control lever must be moved from one extreme position to the other in not more than 1 second except, if regimes of control operations are incorporated necessitating scheduling of the power-control lever motion in going from one extreme position to the other, a longer period of time is acceptable but not more than 3 seconds. In addition, the test prescribed in paragraph (b) must be made. This test may be scheduled as part of the endurance run.

(b) One hundred seventy-five reversals must be made from flight-idle forward thrust to maximum reverse thrust and 25 reversals must be made from rated takeoff thrust to maximum reverse thrust. After each reversal, the reverser must be operated at full reverse thrust for a period of 1 minute, except, that, in the case of a reverser intended for use only as a braking means on the ground, the reverser need only be operated at full reverse thrust for 30 seconds.

§ 33.99 General conduct of block tests.

(a) Each applicant may, in making a block test, use separate engines of identical design and construction in the vibration, calibration, endurance, and operation tests, except that, if a separate engine is used for the endurance test it must be subjected to a calibration check before starting the endurance test.

(b) Each applicant may service and make minor repairs to the engine during the block tests in accordance with the service and maintenance instructions submitted in compliance with § 33.4. If the frequency of the service is excessive, or the number of stops due to engine malfunction is excessive, or a major repair, or replacement of a part is found necessary during the block tests or as the result of findings from the teardown inspection, the engine or its parts must be subjected to any additional tests the Administrator finds necessary.

(c) Each applicant must furnish all testing facilities, including equipment and competent personnel, to conduct the block tests.

[Appendix A

[Instructions For Continued Airworthiness

[A33.1 *General.*

[(a) This appendix specifies requirements for the preparation of Instructions for Continued Airworthiness as required by § 33.4.

[(b) The Instructions for Continued Airworthiness for each engine must include the Instructions for Continued Airworthiness for all engine parts. If Instructions for Continued Airworthiness are not supplied by the engine part manufacturer for an engine part, the Instructions for Continued Airworthiness for the engine must include the information essential to the continued airworthiness of the engine.

[(c) The applicant must submit to the FAA a program to show how changes to the Instructions for Continued Airworthiness made by the applicant or by the manufacturers of engine parts will be distributed.

[A33.2 *Format.*

[(a) The Instructions for Continued Airworthiness must be in the form of a manual or manuals as appropriate for the quantity of data to be provided.

[(b) The format of the manual or manuals must provide for a practical arrangement.

[A23.3 *Content.*

[The contents of the manual or manuals must be prepared in the English language. The Instructions for Continued Airworthiness must contain the following manuals or sections, as appropriate, and information:

[(a) *Engine Maintenance Manual or Section.*

[(1) Introduction information that includes an explanation of the engine's features and data to the extent necessary for maintenance or preventive maintenance.

[(2) A detailed description of the engine and its components, systems and installations.

[(3) Installation instructions, including proper procedures for uncrating, deinhibiting, acceptance checking, lifting, and attaching accessories, with any necessary checks.

[(4) Basic control and operating information describing how the engine components, systems, and installations operate, and information describing the methods of starting, running, testing, and stopping the engine and its parts including any special procedures and limitations that apply.

[(5) Servicing information that covers details regarding servicing points, capacities of tanks, reservoirs, types of fluids to be used, pressures applicable to the various systems, locations of lubrication points, lubricants to be used, and equipment required for servicing.

[(6) Scheduling information for each part of the engine that provides the recommended periods at which it should be cleaned, inspected, adjusted, tested, and lubricated, and the degree of inspection the applicable wear tolerances, and work recommended at these periods. However, the applicant may refer to an accessory, instrument, or equipment manufacturer as the source of this information if the applicant shows that the item has an exceptionally high degree of complexity requiring specialized maintenance techniques, test equipment, or expertise. The recommended overhaul periods and necessary cross references to the Airworthiness Limitations section of the manual must also be included. In addition, the applicant must include an inspection program that includes the frequency and extent of the inspections necessary to provide for the continued airworthiness of the engine.

[(7) Troubleshooting information describing probable malfunctions, how to recognize those malfunctions, and the remedial action for those malfunctions.

[(8) Information describing the order and method of removing the engine and its parts and replacing parts, with any necessary precautions to be taken. Instructions for proper ground handling, crating, and shipping must also be included.

[(9) A list of the tools and equipment necessary for maintenance and directions as to their method of use.

[(b) *Engine Overhaul Manual or Section.*

[(1) Disassembly information including the order and method of disassembly for overhaul.

[(2) Cleaning and inspection instructions that cover the materials and apparatus to be used and methods and precautions to be taken during overhaul. Methods of overhaul inspection must also be included.

[(3) Details of all fits and clearances relevant to overhaul.

[(4) Details of repair methods for worn or otherwise substandard parts and components along with the information necessary to determine when replacement is necessary.

[(5) The order and method of assembly at overhaul.

[(6) Instructions for testing after overhaul.

[(7) Instructions for storage preparation, including any storage limits.

[(8) A list of tools needed for overhaul.

[A33.4 *Airworthiness Limitations section.*

[The Instructions for Continued Airworthiness must contain a section titled Airworthiness Limitations that is segregated and clearly distinguishable from the rest of the document. This section must set forth each mandatory replacement time, inspection interval, and related procedure required for type certification. If the Instructions for Continued Airworthiness consist of multiple documents, the section required by this paragraph must be included in the principal manual. This section must contain a legible statement in a prominent location that reads: "The Airworthiness Limitations section is FAA approved and specifies maintenance required under §§ 43.16 and 91.163 of the Federal Aviation Regulations unless an alternative program has been FAA approved."]

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